HNOLOGY DEPT.

ECEMBER, 1956

RUBBER WORLD

ontents, page 411

NOW IN ITS 68th YEAR

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INFLUENCE OF NITROGEN DIOXIDE ON THE AGING OF FOAM RUBBER

By Goebel, Bergmeyer, Brass, Mann, page 421

Four Benefits of Using
DU PONT RR-10

• Increased Reclaiming Efficiency and Quality of Reclaim

With RR-10 you can speed up reclaiming operations and increase quality. Its action is so powerful that less reclaiming oil is required. This means a lower acetone extract reclaim and also one that processes easily and extrudes smoothly. Such reclaims have good tack but are not mushy.

Natural rubber and GR-S, or mixtures of these two rubbers, and butyl, too, can be reclaimed quickly and economically. RR-10 is used successfully in the pan and zinc-chloride processes and in Banbury reclaiming operations. It is also effective in the alkali process.

• Reclaim Your Own Scrap

Rubber manufacturers can reclaim their own scrap easily by using RR-10. Doing this helps keep costs down by converting scrap to usable material.

• A Processing Aid for Neoprene Stocks

If your neoprene stocks are tough or become partially set up or scorched, they can be smoothed out for good processing with RR-10. Usually 3 PHR, rarely as much as 5 PHR of RR-10 does the trick.

Some neoprene users add a little RR-10 to the original compound, if it is sensitive to scorch, to prevent set-up. Only 1 to 2 PHR is required.

• Very Low Modulus Neoprene Stocks

Very low modulus and high elongation can be obtained in neoprene stocks by the addition of RR-10. Such compounds have much better physical properties than if comparable modulus and hardness are obtained by loading with large amounts of oil. Stocks containing RR-10 have excellent processing safety.

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BETTER THINGS FOR BETTER LIVING ... THROUGH CHEMISTRY

RUBBER WORLD, December, 1956, Vol. 135, No. 3. Published monthly by BILL BROTHERS PUBLISHING CORP., Office of Publication, 1309 Noble Street, Philadelphia, Pa., with Editorial and Executive Offices at 386 Fourth Avenue, New York 16, N. Y., U.S.A. Entered as Second Class Matter at the Post Office at Philadelphia, Pa., under the act of March 3, 1879. Subscription United States $5.00 per year; Canada $6.00. All other countries $7.00. Single Copies 50 cents. Address Mail to N. Y. Office.

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News about

B.F.Goodrich Chemical *raw materials*

name your problem...

HYCAR CAN SOLVE IT!

IF THIS IS YOUR PROBLEM:

HERE'S THE ANSWER:

You manufacture shoe soles, floor tiling or similar semi-hard products that demand "leather-like" rubber compounds. Hycar 2007, a high styrene copolymer in resin form, fills the bill. Easy to use, this material makes high quality rubber compounds in any range of hardness.

Hycar 2007

You need an excellent non-migrating, non-volatile, non-extractible plasticizer for rubber and plastic compounds. The answer is Hycar 1312, a *liquid* nitrile polymer. It can also be cured to hard rubber stage without requiring costly processing equipment.

Hycar 1312

Or you must have a modifying agent that improves the smoothness of extrusions and calendered goods. Hycar 1411, a high acrylonitrile copolymer, is specially designed to blend easily with other Hycar rubbers to achieve this quality.

Hycar 1411

You make working parts for the oil, automotive and aircraft industry that must stand up to air and hot oil at temperatures above 300°F. Hycar 4021, an acrylic ester copolymer, extends the useful temperature range of rubber to 350°F for continuous and 500°F for intermittent service.

Hycar 4021

You make chemically blown GR-S sponge and want to simplify compounding and cut costs. A *liquid* GR-S polymer, Hycar 2000X68, has been developed to meet these requirements. It can be easily, economically blended with standard GR-S for use in applications now being served by GR-S 1010.

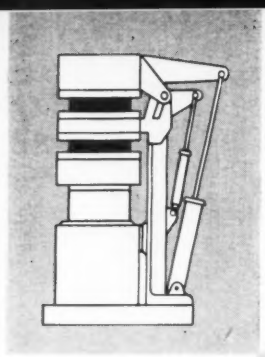
Hycar 2000 x 68

These are only a few examples of the wide range of Hycar American Rubbers that are tailored to meet specific requirements. For copies of available literature listing the properties of standard materials, write Dept. ES-12, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

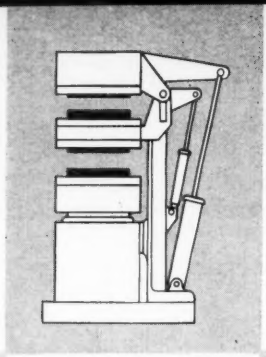
Hycar
Reg. U.S. Pat. Off.
American Rubber

B.F.Goodrich Chemical Company
A Division of The B.F.Goodrich Company

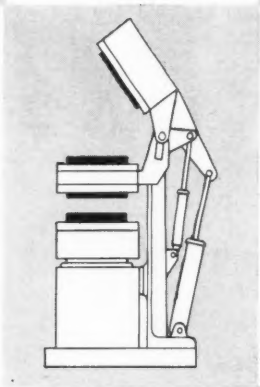
B.F.Goodrich **GEON polyvinyl materials • HYCAR American rubber and latex • GOOD-RITE chemicals and plasticizers • HARMON colors**



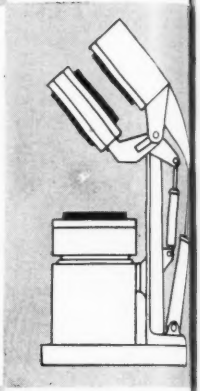
1 Completion of cure Press is ready to open.



2 Press opens. Molds remain parallel during entire stroke of ram. This is necessary for deep cavity molds.



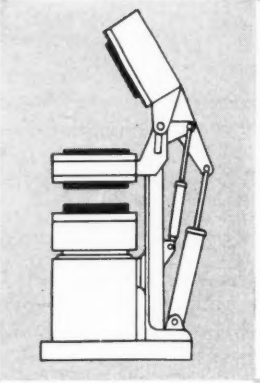
3 Head tilts back, exposing two halves of mold in top deck—cured articles are removed.



4 Intermediate platen back, exposing halves of mold in deck. Cured articles removed. Fresh unvulcanized stock is placed in mold cavities.

deep, shallow or transfer molding easier with the

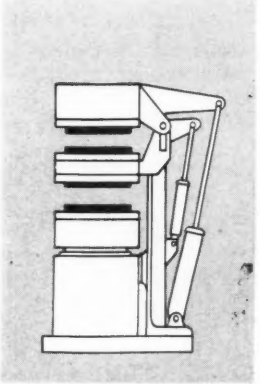
TILTING HEAD



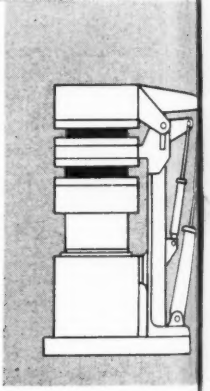
5 Intermediate platen lowers into parallel position—unvulcanized stock is inserted in mold cavities.

- Only the material moves in and out of the press. Molds remain in press, therefore mold halves stay in register.
- Cures two sets of molds at the same time.
- Timer, at prescribed intervals, automatically raises and lowers the ram, tilt head and intermediate platen.
- One operator, male or female, can attend to approximately as many presses as there are minutes in cure time. The operator simply removes cured articles and replaces with uncured, pre-formed stock.
- Press Sizes: 24-32-36" — up to 1,000-ton pressure.
- Two-Opening Press can be used as a single opening press for extremely deep molds.

REMOVE THE WORK WITHOUT REMOVING THE MOLDS



6 Head is lowered into parallel position.



7 Ram travels upward and closes press. RECT AND FULL P SURE OF HYDRA SYSTEM IS AVAILA THROUGHOUT EN STROKE OF RAM.

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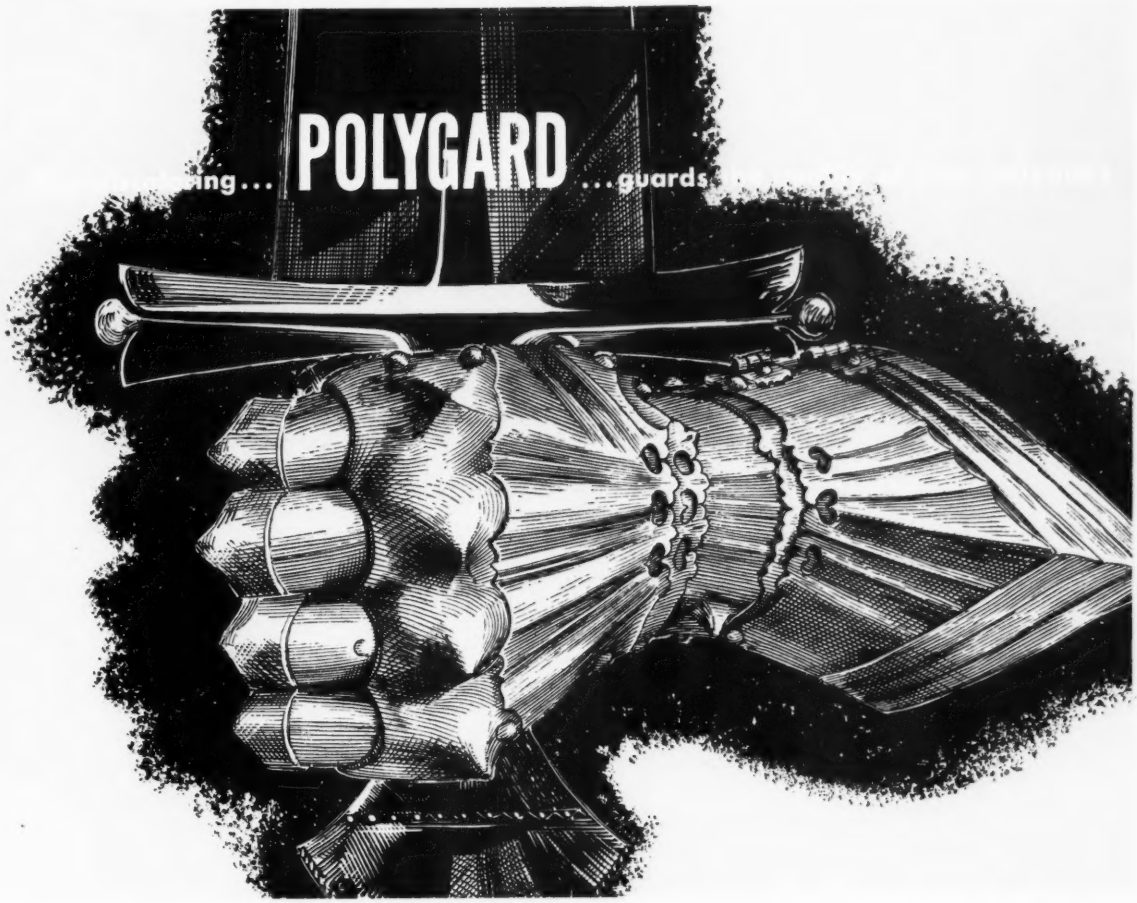

...during manufacture, storage, processing, and use

AS A STABILIZER for *all* types of rubber latices, and for the manufacture of nonstaining synthetic polymers, POLYGARD®:

prevents resinification of the polymer during manufacture and storage,

guards against heat and oxygen degradation during processing,

resists cut-growth degradation caused by gel and resinification.

POLYGARD has the added advantage of being *non-discoloring, nonstaining* and *odorless!* Added to the polymer emulsion prior to flocculation, POLYGARD's superior protective action is not diminished by the acid serum commonly encountered in coagulating R-S rubber. Because of its liquid form it disperses easily and uniformly in the emulsion. May we send you more detailed data?

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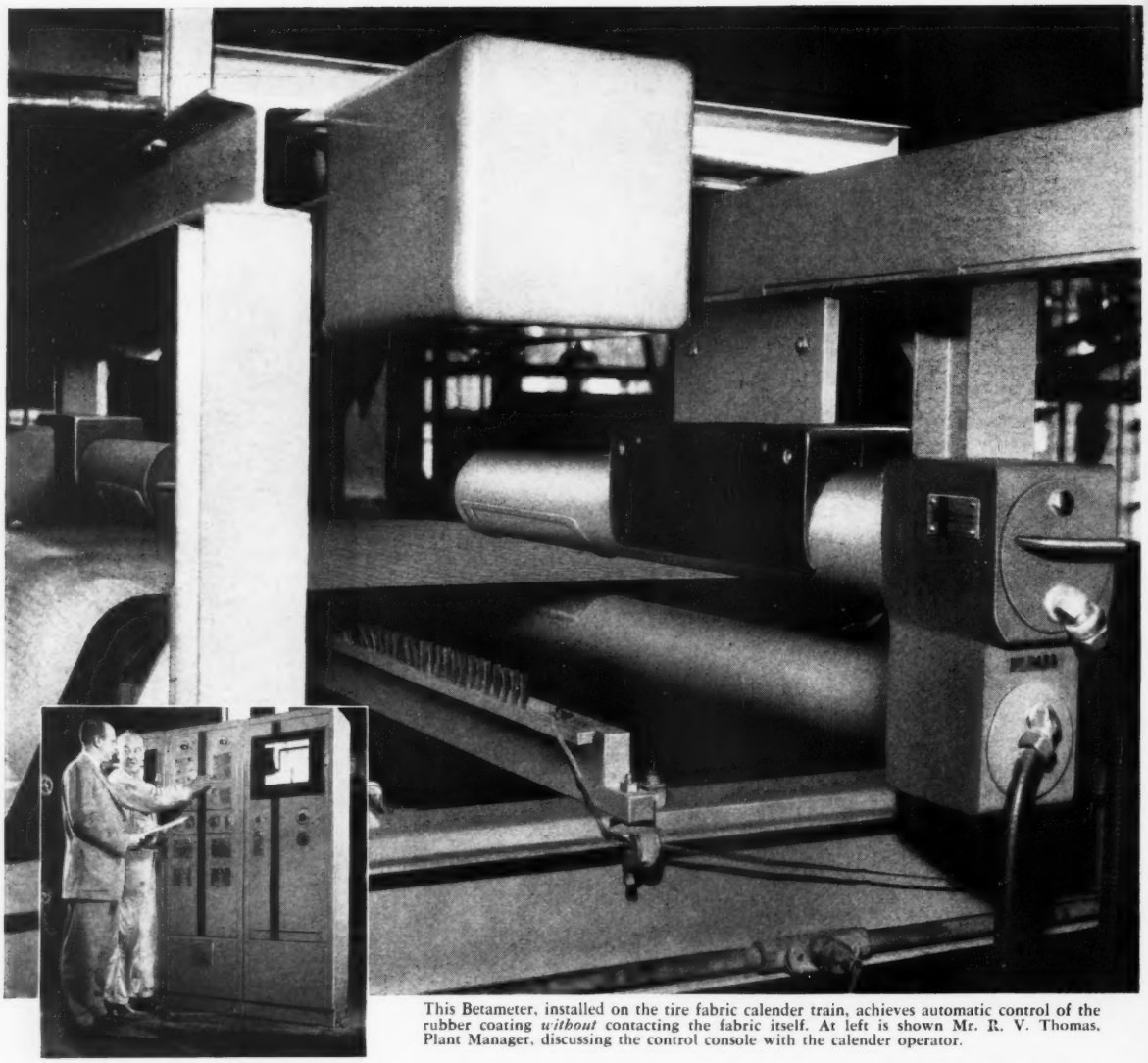
Naugatuck, Connecticut

IN CANADA: NAUGATUCK CHEMICALS DIVISION • Dominion Rubber Company, Limited, Elmira, Ontario • Rubber Chemicals • Synthetic Rubber • Plastics • Agricultural Chemicals • Reclaimed Rubber • Latices • Cable Address: Rubexport, N.Y.



This Betameter, installed on the tire fabric calender train, achieves automatic control of the rubber coating *without* contacting the fabric itself. At left is shown Mr. R. V. Thomas, Plant Manager, discussing the control console with the calender operator.

THE ISOTOPE PRODUCTS BETAMETER NOW HELPS GOODYEAR MAKE BETTER TIRES

This unit is installed on a tandem calender in the West Coast plant of the Goodyear Tire & Rubber Company. Twin sets of measuring heads are used on the pass line after each of two calender rolls to obtain more uniform rubber coating on each side of the fabric. "The Isotope Products Betameter offers all of the 'extra' features necessary to dependable automatic control of our calender operation . . ." says Mr. R. F. Snyder of the Akron Design Engineering Department. . . . The unit has a dual source detector combination for point source profile scanning or a distributed source for automatic control using average sample measurement. The null balance circuit permits simpler electronic design for continued accuracy and stability.

. . . The recorder chart is synchronized to the fabric speed thru the calender. The time is independently stamped on the chart for control analysis. The calender roll screw position is indicated on the control console to simplify adjustment.

. . . It is possible to determine the profile of the entire 60" web both before and after the final calender.

"Since installing the Betameter control on our calender train, we have made a striking improvement in the control and uniformity of our tire cord gum coating . . . our customers receive more durable and uniform tires at no additional cost for materials or labor . . ." states Mr. R. V. Thomas, Plant Manager. Additional units have been ordered by other Goodyear Plants — outstanding evidence that Isotope Products represent the ultimate in radiation gaging engineering.

Find out today how Isotope Products gaging equipment can automatically control your process. Write for Bulletin R.

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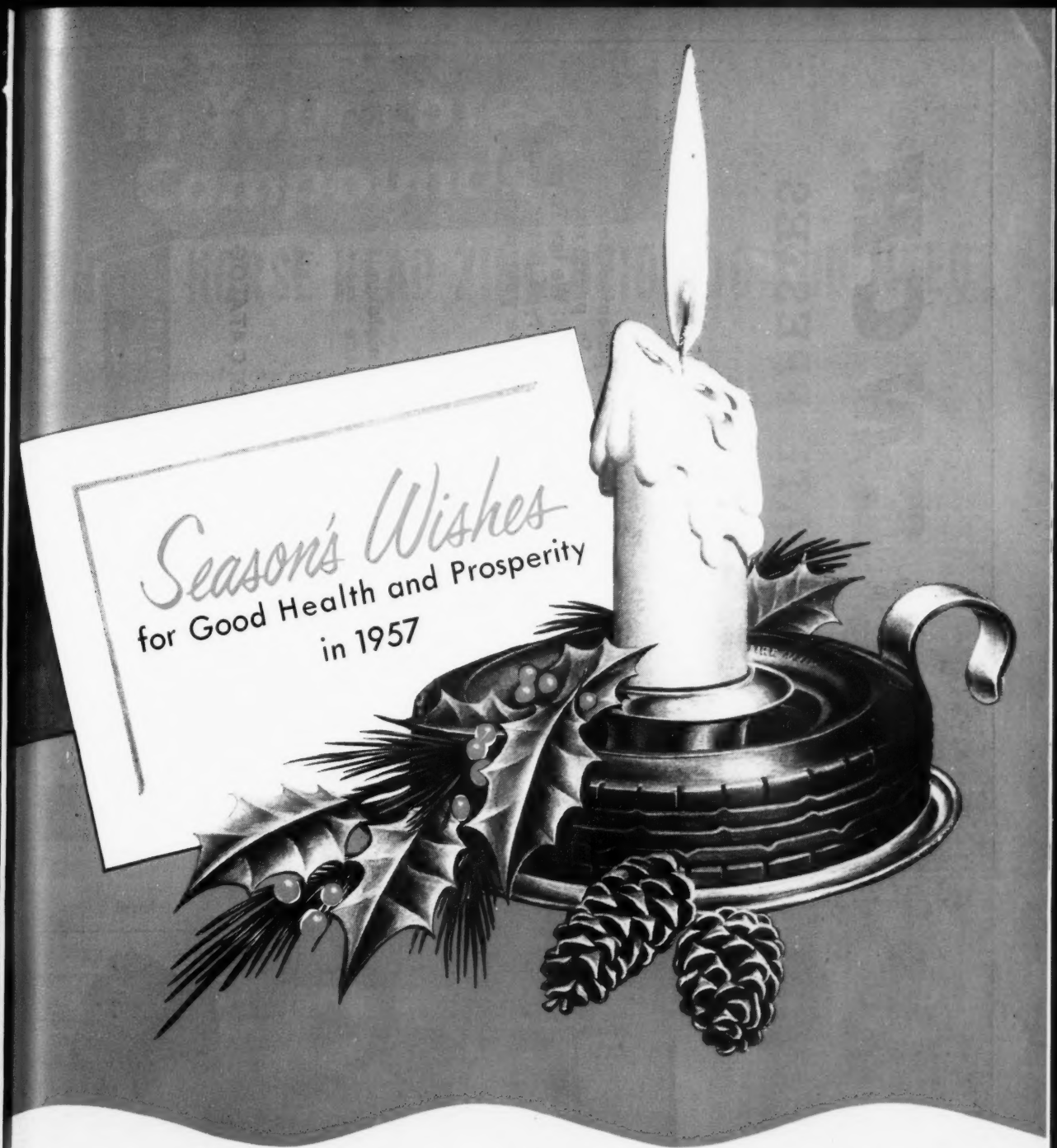

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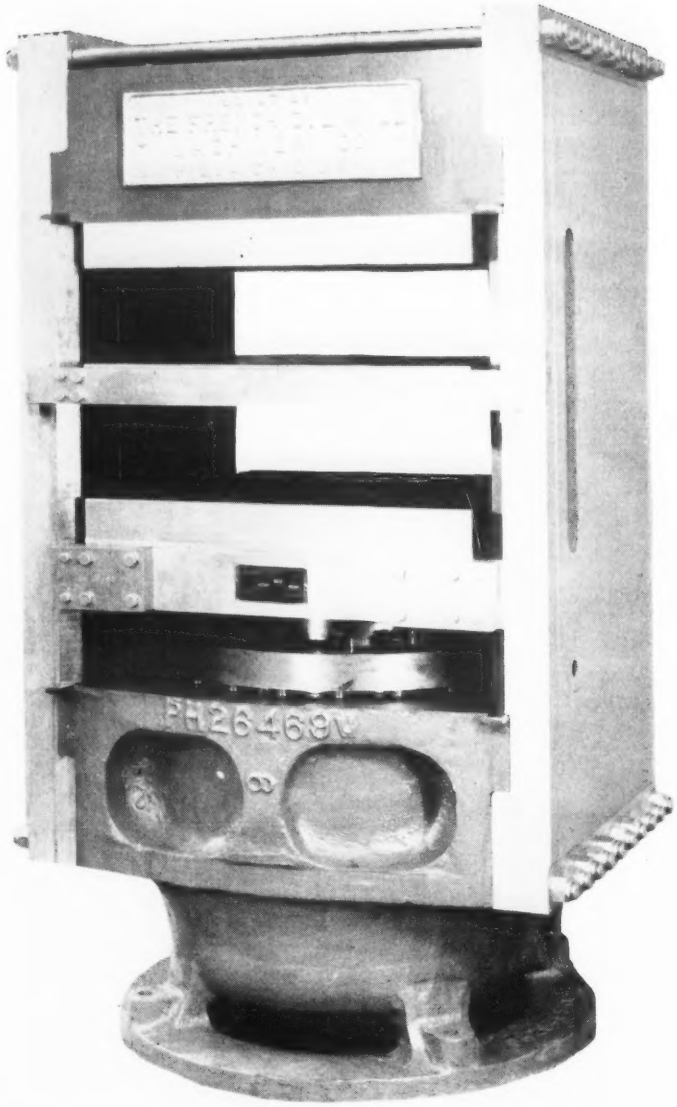
CRUDE RUBBER · SYNTHETIC RUBBER · SCRAP RUBBER · HARD RUBBER DUST · PLASTIC SCRAP



FRENCH

SIDE-PLATE PRESSES

Accepted by most of the rubber industry as the finest rubber molding press available.

French side plate presses with patented construction features offer you the most in press rigidity, molding accuracy, and low maintenance. We invite you to investigate the advantages of this type press, and find how you can profit from its use in your plant.

Standard sizes available.

- **Improve close tolerance molding**
- **Decrease mold maintenance**
- **Minimize scrap losses**

WRITE FOR ILLUSTRATED CATALOG

THE FRENCH OIL MILL MACHINERY CO.
(HYDRAULIC PRESS DIVISION)
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In Your Latex Compounds...

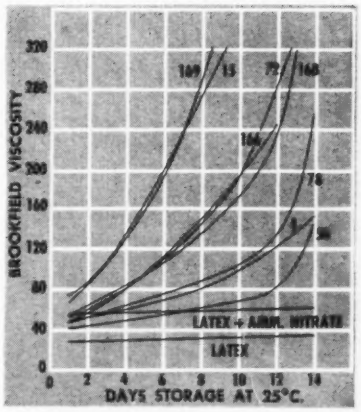
WHICH HORSE HEAD ZINC OXIDE DO YOU NEED?

Most formulators agree that zinc oxide is the most critical ingredient to select for latex use.

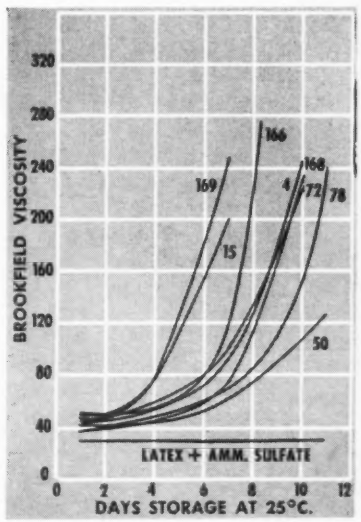
Here's why:

1. YOU can choose from many types of zinc oxides, and each type influences such important properties of latex compounds as viscosity, suspension, stability, rate of gelation and rate of cure.
2. YOU can't predict the influence of any type of zinc oxide on the properties of your latex compound . . . because the influence of a zinc oxide depends upon the specific latex formulation, as shown in the charts at right.

So . . . for best results, test the widest range of types—the Horse Head family—including the exclusive Kadox and Protox* brands.



Influence of zinc oxides on the chemical stability of latex containing 1% NH_4NO_3



Influence of zinc oxides on the chemical stability of latex containing 1% $(NH_4)_2SO_4$.

HORSE HEAD ZINC OXIDES FOR LATEX

Brand	Surface Area (Sq. M /Gm.)	Process of Mfg. American	Process of Mfg. French	Propionic Acid Surface Treatment
XX-50	3.0	✓		
XX-78	3.9		✓	
XX-4	4.4	✓		
Protox–166	4.4	✓		✓
Kadox–72	7.9		✓	
Protox–168	7.9		✓	✓
Kadox–15	10.0		✓	
Protox–169	10.0		✓	✓

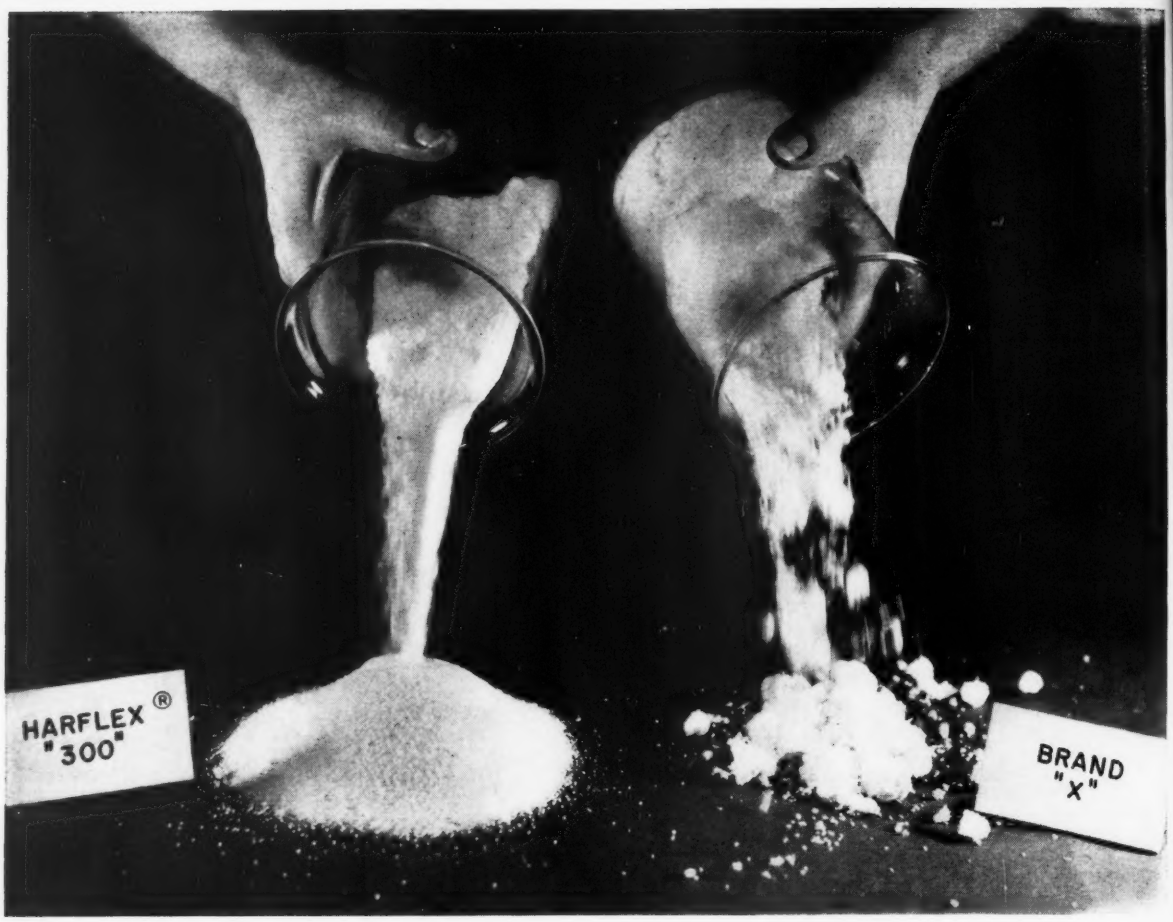
*U. S. Patents 2,303,329 and 2,303,330

THE NEW JERSEY ZINC COMPANY

Producers of Horse Head Zinc Pigments

. . . most used by rubber manufacturers since 1852

160 Front Street, New York 38, N. Y.



HARFLEX® 300

PERMITS A FREE FLOWING DRY BLEND

In a typical test, 64 parts of **HARFLEX®** 300, preheated to 212°F, were mixed with 100 parts of an easy-processing polyvinyl chloride resin at 212°F. After 30 minutes of thorough agitation, a dry, free flowing powder was obtained which could be put directly into an extruder. When a free flowing dry blend is used directly, as in extrusion operations, it is possible to eliminate or minimize extra operations such as Banbury mixing or roll milling.

HARFLEX® 300 is a permanent polymeric plasticizer, readily adaptable to dry blending. Write for our free technical bulletin that gives full information about **HARFLEX®** 300. Samples for your test or experimental work are also available at your request.

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It Could Put Your Product in a New Light, Too

Here is a development that may well put a product of yours in a completely new light or even inspire a totally new one. It's the substantial improvement made in the color of PLIOFLEX to give industry the best, complete line of nonstaining, non-discoloring rubbers currently available.

The true significance of this new, light color of PLIOFLEX lies not in a mere product improvement, but in the opportunities it offers for new and wider uses of synthetic rubber. Now, with PLIOFLEX, designers and manufacturers can combine the resilience, flexibility, elasticity and other desirable properties of a true elastomer with the delicate colors so much in demand—and do so at a reduced cost.

Why not learn more about the new, light color of PLIOFLEX? Find out how it can help you to new or improved products by writing to: Goodyear, Chemical Division, Dept. X-9418, Akron 16, Ohio.

Plioflex
general purpose synthetic rubber

CHEMICAL
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RUBBER &
RUBBER CHEMICALS
DEPARTMENT

Chemigum, Plioflex, Pliolite, Plio-Tuf, Pliovic—T. M.'s The Goodyear Tire & Rubber Company, Akron, Ohio

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High Polymer Resins, Rubbers, Latices and Related Chemicals for the Process Industries

NOT A CHANCE FOR CRUMB TO CAKE

in

SARGENT'S

new three-decker

RUBBER DRYER

Rubber crumb moving through a dryer has an annoying tendency to cake. It was always a bogie until Sargent did something about it. They designed a simple and highly effective intermeshing type of stock breaker that provides a positive means for breaking the crumb into fine particles as it transfers from one conveyor to another, or from conveyor to delivery.

THERE IS NO CHANCE
FOR THE DRYING CRUMB
TO CAKE OR BUILD UP.

This is only one of the many exclusive Sargent advanced engineering features of their new, 11 section, 3 conveyor dryer designed for synthetic rubber. Separate sections, for example, are provided at entering and delivery ends (away from the heat of the drying chambers) to house all driving mechanisms, cleaning mechanism and Alemite System. The entire non-fan side of the dryer is a series of full-height hinged panels for easy access to any part of the dryer interior. The same hinged panels are placed wherever possible on the fan side also, so there is not one hidden or hard-to-reach spot in the dryer's entire 62 feet length. Guaranteed minimum production is 5,000 pounds per hour at entering moisture content of 35%. Leaving dryer, moisture content of the rubber crumb is a constant 0.5%.

The dryer has the usual Sargent rugged, sturdy construction and as with all Sargent dryers, installation at customer's plant is effected in record-quick time. It is completely automatic from feed to delivery, and in operation requires a minimum of operator attention.

A Sargent-designed continuous automatic feed delivers a steady, even bed of rubber crumb to the stainless steel conveyor. In addition to the traveling stock guides along the steel conveyor flights, stationary stock guides are provided to prevent any material being blown on to the driving chains. Safety shear pins are provided at each drive to prevent damage from accidental jamming of the conveyor. Every known safety device for protection of personnel, machine, and stock, is employed in this dryer.

A Sargent rubber dryer can help YOU to better production at lowered operating costs. Just write your nearest representative, or write us direct, for information.

C. G. SARGENT'S SONS CORPORATION

Graniteville, SINCE 1852 Massachusetts

Drying and Cooling Machinery for all Process Industries

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Vinyl compounders –

you benefit by specifying plasticizers made from

Indoil

OXO ALCOHOLS

Here's how—You sell finished product by volume rather than by weight. You get the most volume at lowest cost by buying plasticizers on the basis of volume of finished product, not weight of finished product. At equal cost per pound Oxo Alcohol plasticizers such as DIOP and DDP are cheaper to use. Here is a comparison:

	DOP	DIOP	DDP
Density 20/4	0.983	0.983	0.963
EMC* at 1,600 psi	50.3	51.4	53.7

**Equivalent Modulus Concentration (phr)*

INDOIL plastics evaluation laboratory checks quality of INDOIL Alcohols by testing finished product. Here operator measures elongation of plasticized vinyl strip to determine Equivalent Modulus Concentration of plasticizer.

No need to reformulate—Compounders plasticizing with DOP need not refigure formulations in order to use DIOP or DDP. They can be modified by using this table:

	Ratio $\frac{\text{Plasticizer phr}}{\text{DOP phr}}$	
	100% Elong. at 1,600 psi	100% Elong. at 900 psi
DOP	1.000	1.000
DIOP	1.022	1.019
DDP	1.068	1.086

Contact your supplier—Ask your plasticizer manufacturer for samples of DIOP, DDP and other esters made with INDOIL Oxo Alcohols. INDOIL Chemical Company does not manufacture esters.

Information—Send for INDOIL Bulletins Nos. 22 and 23.

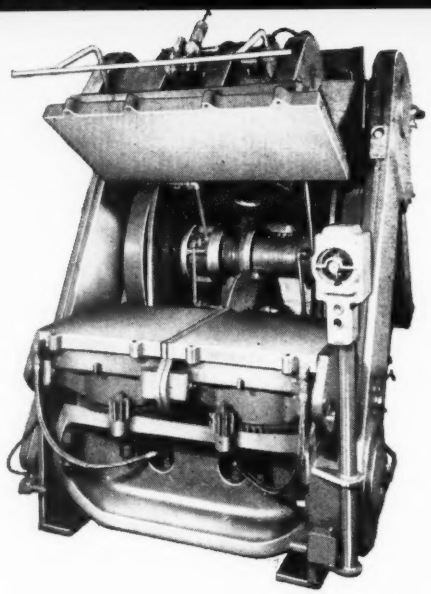
INDOIL®
CHEMICAL PRODUCTS

INDOIL CHEMICAL COMPANY, 910 South Michigan Avenue, Chicago 80, Illinois

McNEIL-AKRON MODEL 800-32 TWIN PRESS

One of McNEIL's four heavy-duty "800" models in each of which the mold is contained within the press at all times. This prevents heat loss and possible mold damage during loading and unloading, saves operator's work and time. All models have finest safety and operating controls. All are designed, engineered and manufactured by experienced craftsmen for unequalled, precision performance!

Shown is McNEIL Model 800-24 Twin Press that accommodates two 24" x 24" molds of varying thickness or one 24" x 48" mold. Over-all dimensions: 5'6¾" wide x 7'3¾" deep x 7'7⅝" high closed, or 7'0⅞" open.

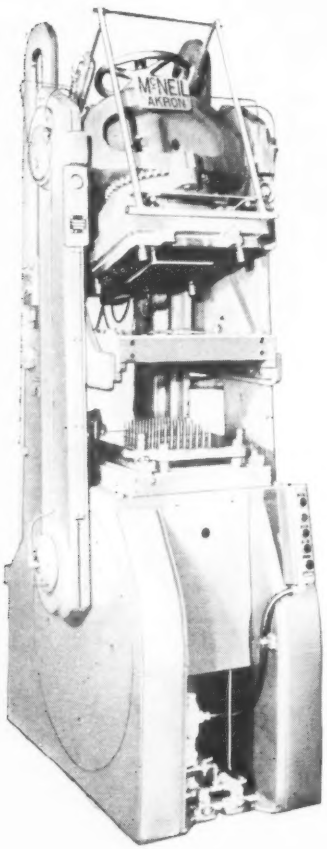


A Money-Making Model for Every Production Requirement

NEW McNEIL-AKRON MODEL 300 PRESS

Fast-operating 18" x 18" "Big Brother" to our 10" x 16" "Bantam." Designed for quick transfer molding of small, close-tolerance products, this unit is adaptable to single or double daylight opening compression molding. Available with mechanical or air knockout mechanism. An automatic, efficient, high production unit. Over-all measurements: 2'11" wide x 5'9½" deep x 7'5¾" high closed, or 8'4¾" open. Requires only 18 sq. ft. of floor space.

McNEIL-AKRON MECHANICAL GOODS PRESSES



—Dependable, Efficient, Versatile, Speedy!

If you want better, easier, faster, safer and lower-cost production of mechanical rubber goods, you can get all that—and more besides—with McNEIL-AKRON Presses.

Included in the complete line of standard McNEIL-AKRON'S are both light-duty (zero to 110,000 lbs.) and heavy-duty (zero to 800,000 lbs.) models. Platen sizes range from 10" x 16" to 24" x 188". All of these famous presses, some of which are shown here, are dependable, efficient units of remarkable versatility. Handling everything from sponge and blown products to hard rubber and many plastic items, they also can be modified and adapted for a wide variety of special uses.

All McNEIL-AKRON models are compact, high-speed production units that provide constant mold temperatures, faster cures and consistently high quality production. All are electrically-operated with no pumps to service and no rams to pack. All models are equipped with automatic timers that govern the curing periods and also establish and regulate the bumping sequences and time intervals. All have automatic lubrication. And all models are built to McNEIL *precision* and quality standards and are as reliable and maintenance-free as only a McNEIL Press can be!

Best of all, every McNEIL-AKRON Press is a profit-producer. Economical to buy, own and operate, it will quickly pay for itself in profitable production! Consult us on your molding problems.

THE McNEIL MACHINE & ENGINEERING CO.

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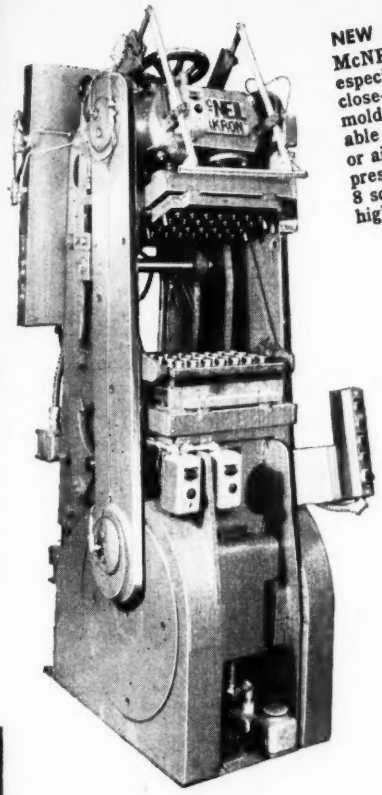
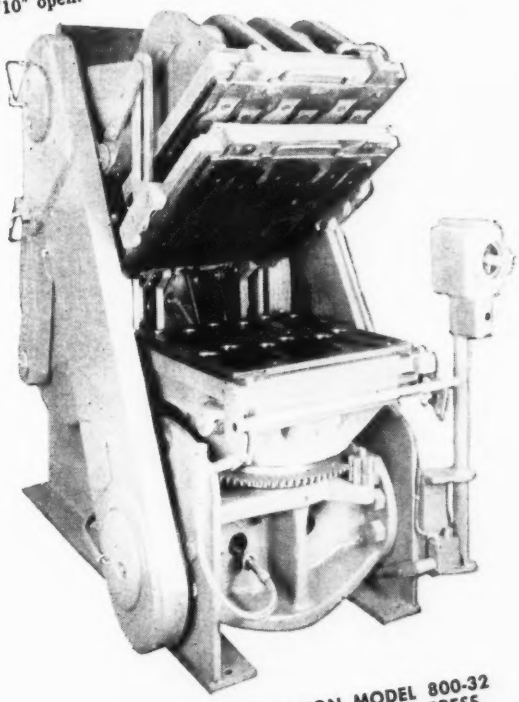


NEW McNEIL-AKRON MODEL 150 PRESS

McNEIL'S speedy 10" x 16" "Bantam," designed especially for transfer molding of small, intricate and close-tolerance parts. Handles 2-, 3- and 4-plate molds automatically. For compression molding, adaptable to single or double daylight opening. Mechanical or air knockout mechanism. 1000-lb. per sq. in. platen pressure and 400°F. temperature limits. Requires only 8 sq. ft. of floor space. 26½" wide x 44" deep x 5'10" high closed, or 6'10" open.



McNEIL-AKRON MODEL 800-32 INTERMEDIATE PLATEN PRESS

Another McNeil heavy-duty unit, built to meet the demands for tomorrow's higher production requirements. Equipped with a center platen automatically handled by press mechanism. Available with 32" x 32" platens in 8" and 10" maximum daylight openings. Maximum dimensions: 4'2½" wide x 7'4¼" deep x 7'9⅝" high closed, or 7'2⅛" open. No ejector mechanism.

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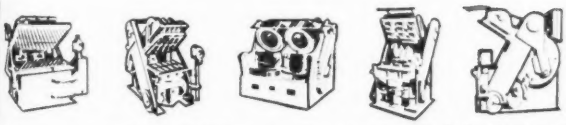

MANUFACTURING AGENTS: Francis Shaw & Company, Ltd., Manchester, England; Vickers-Ruwolt Proprietary, Ltd., Victoria, Australia; Luigi Pomini, Soc. in Acc. di Luigi e Carlo POMINI fu Egidio e C, Castellanza, Province of Verese, Italy; Etablissements Repiquet, Bobigny (Seine), France; Harburger Eisen Und Bronze-Werke A. G., Hamburg-Harburg, Germany.

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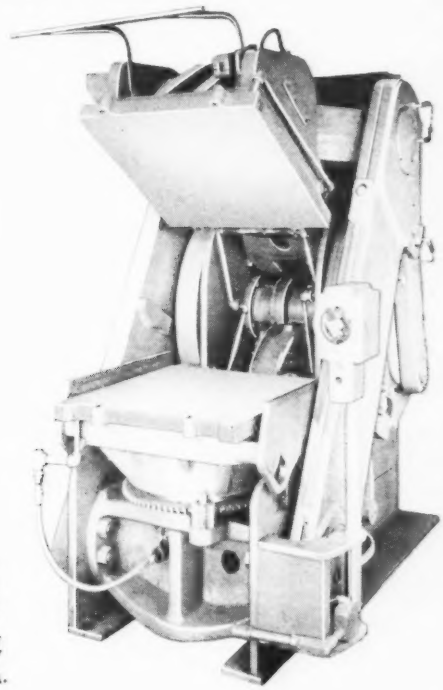

McNEIL-AKRON MODEL 800-32 PRESS WITH EJECTOR

Still another heavy-duty McNEIL, shown here with adjustable ejector but also available without it. Has 32" x 32" drilled steam platen. Can be equipped with electric platens. Available with 6", 8", 10" and 12" maximum platen openings. Over-all dimensions vary with these openings but maximum size is 4'2½" wide x 7'4¼" deep x 7'11⅝" high closed, or 7'6" open.

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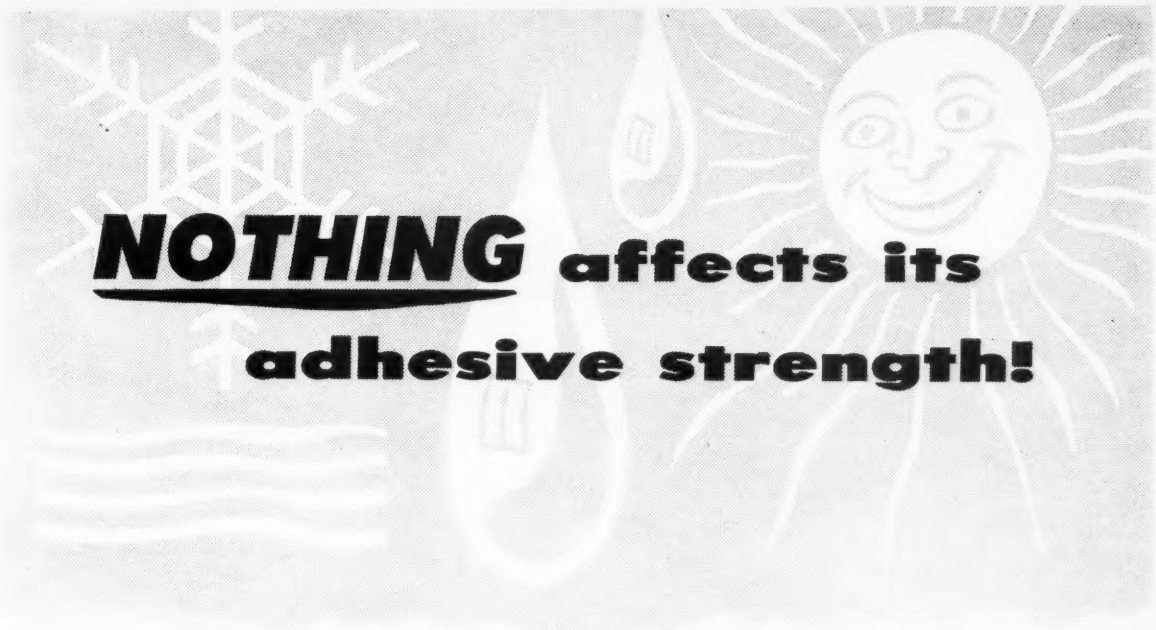

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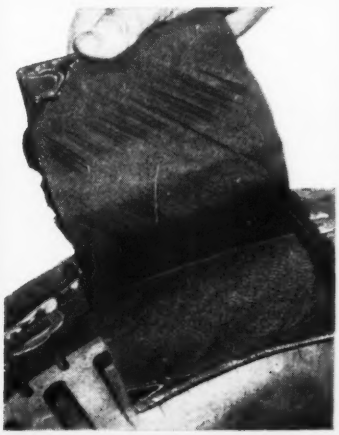
That's right! Even when frozen and thawed, Gen-Tac's outstanding quality remains unaffected. When subjected to freezing temperature for hours at a time, Gen-Tac won't break down. Gen-Tac, General's proven vinyl pyridine latex, has excellent freeze stability, and assures the best fabric-to-rubber adhesion in tires and other applications. Write for literature and samples to The General Tire & Rubber Company, Chemical Division, Akron, Ohio.

Moisture degradation — Gen-Tac keeps this from happening to your tires. Cord treated with Gen-Tac adheres to rubber so well that moisture doesn't "wick" in to loosen the cords.



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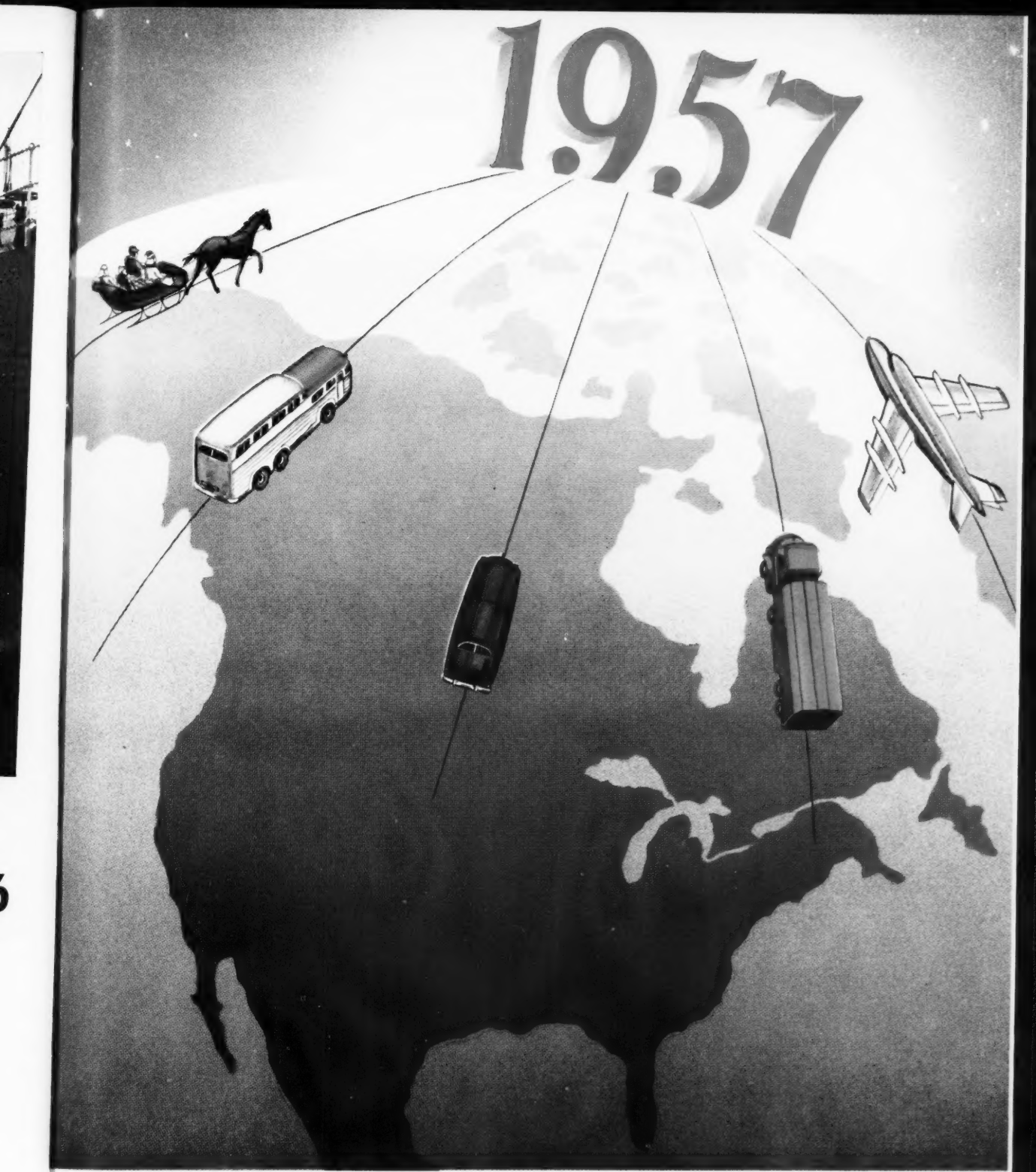

In whatever manner you travel and in whatever way you go,
may the trail into the holidays and the year that lies ahead
lead you into pathways that are happy and prosperous.

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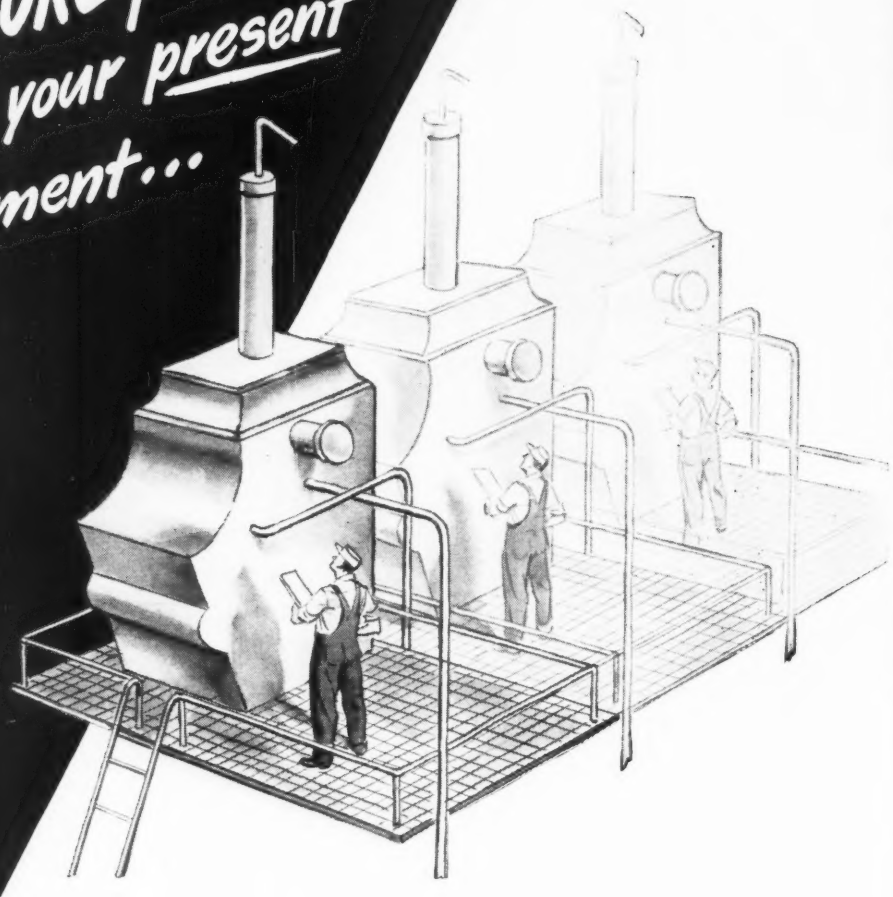

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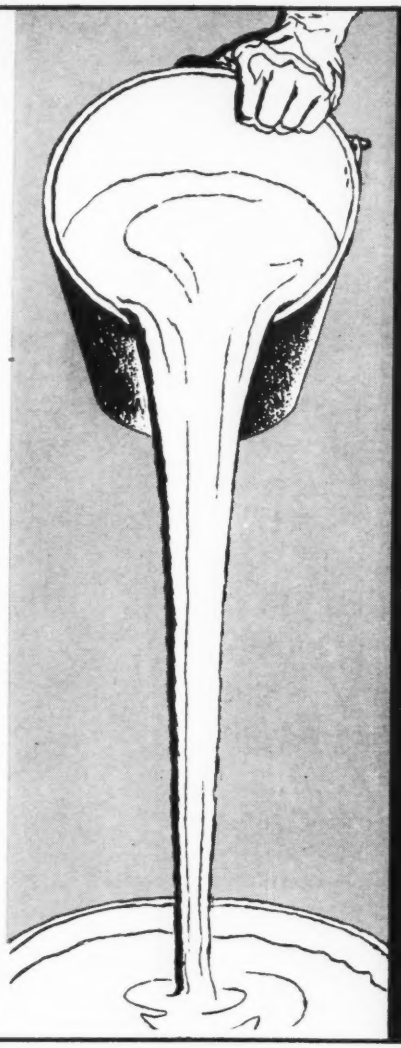

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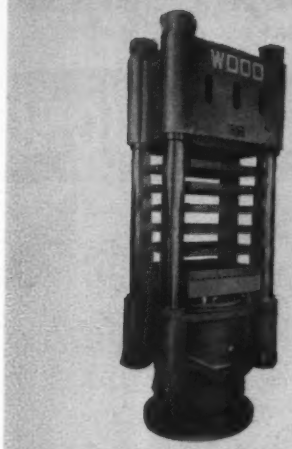

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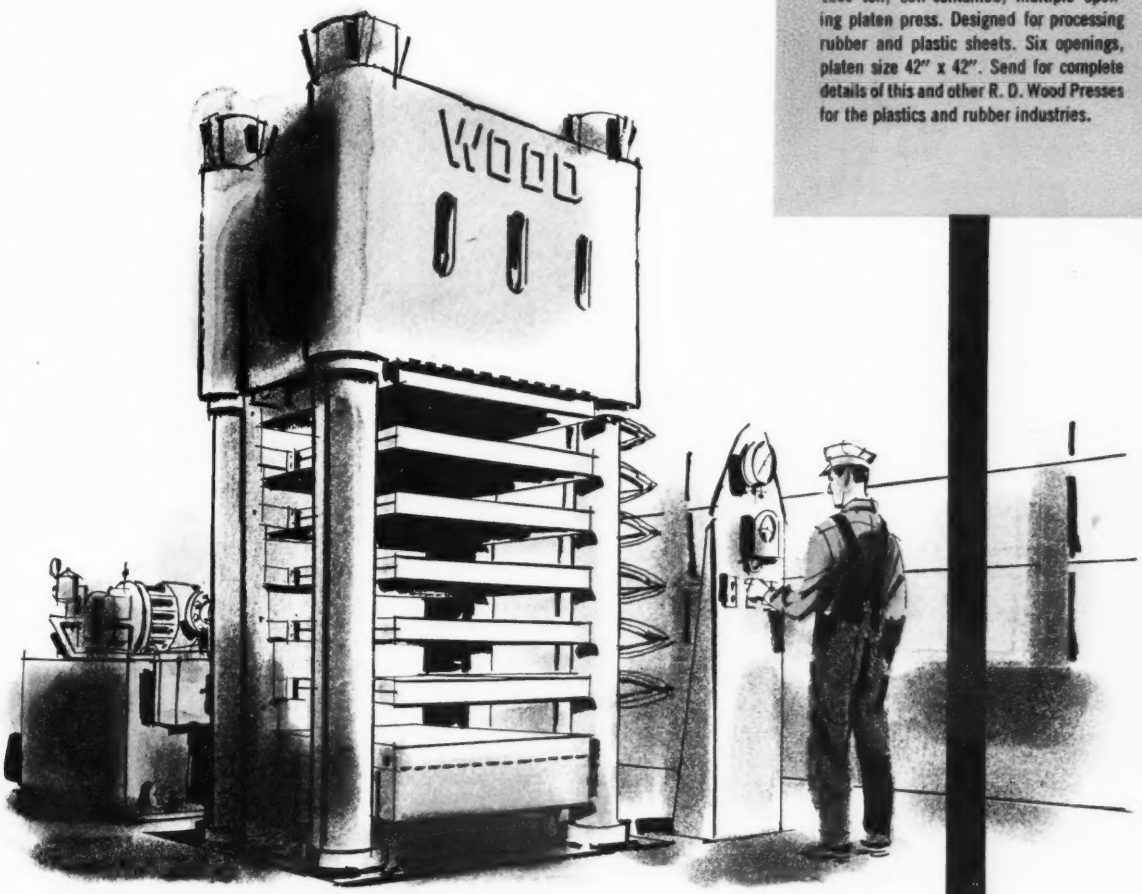

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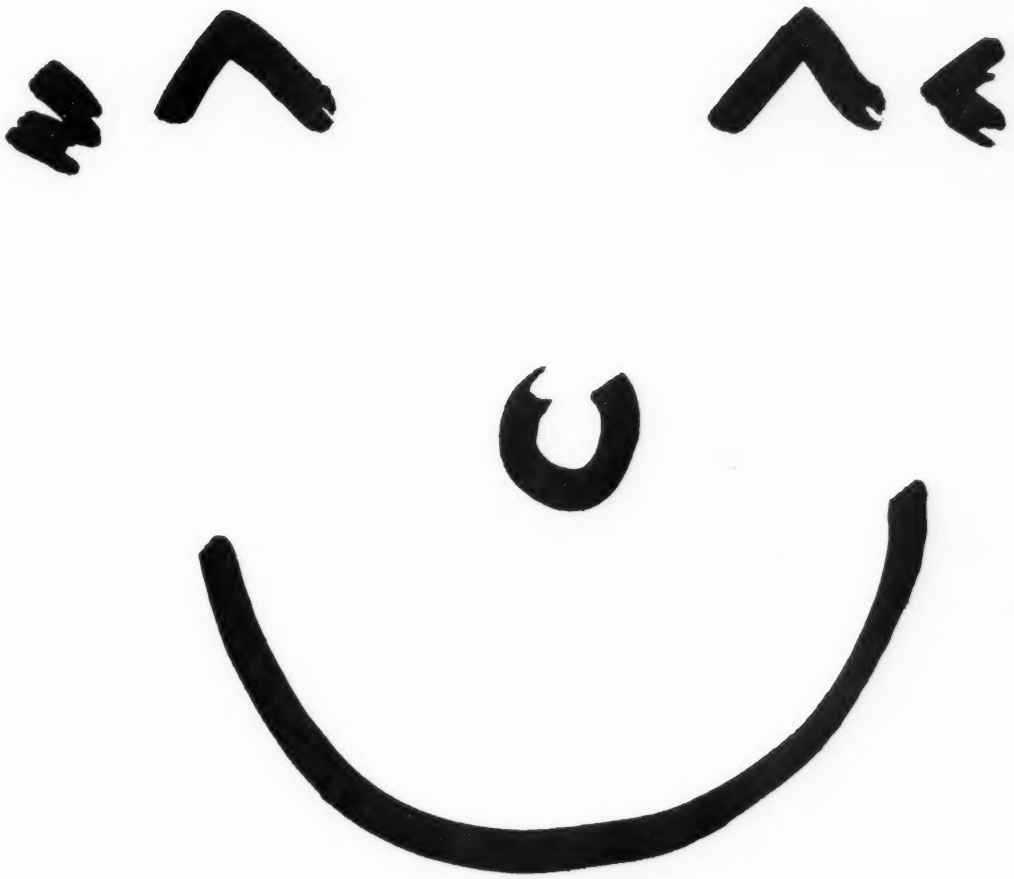

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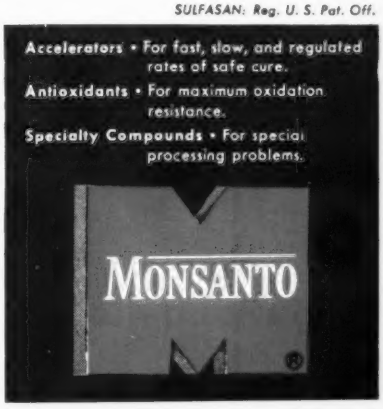
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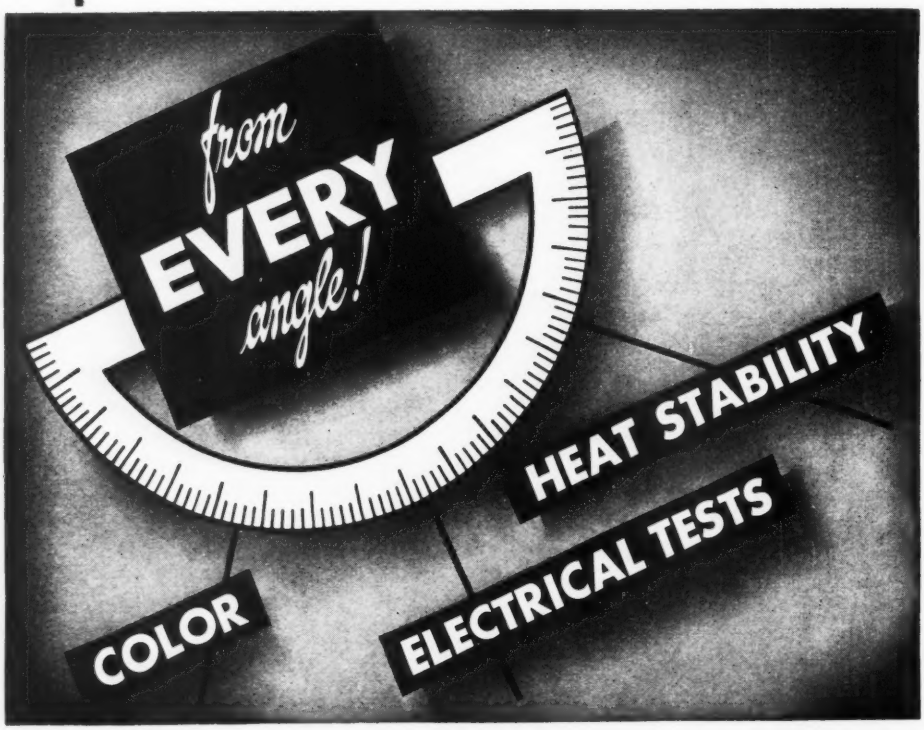

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Plant and Laboratory,
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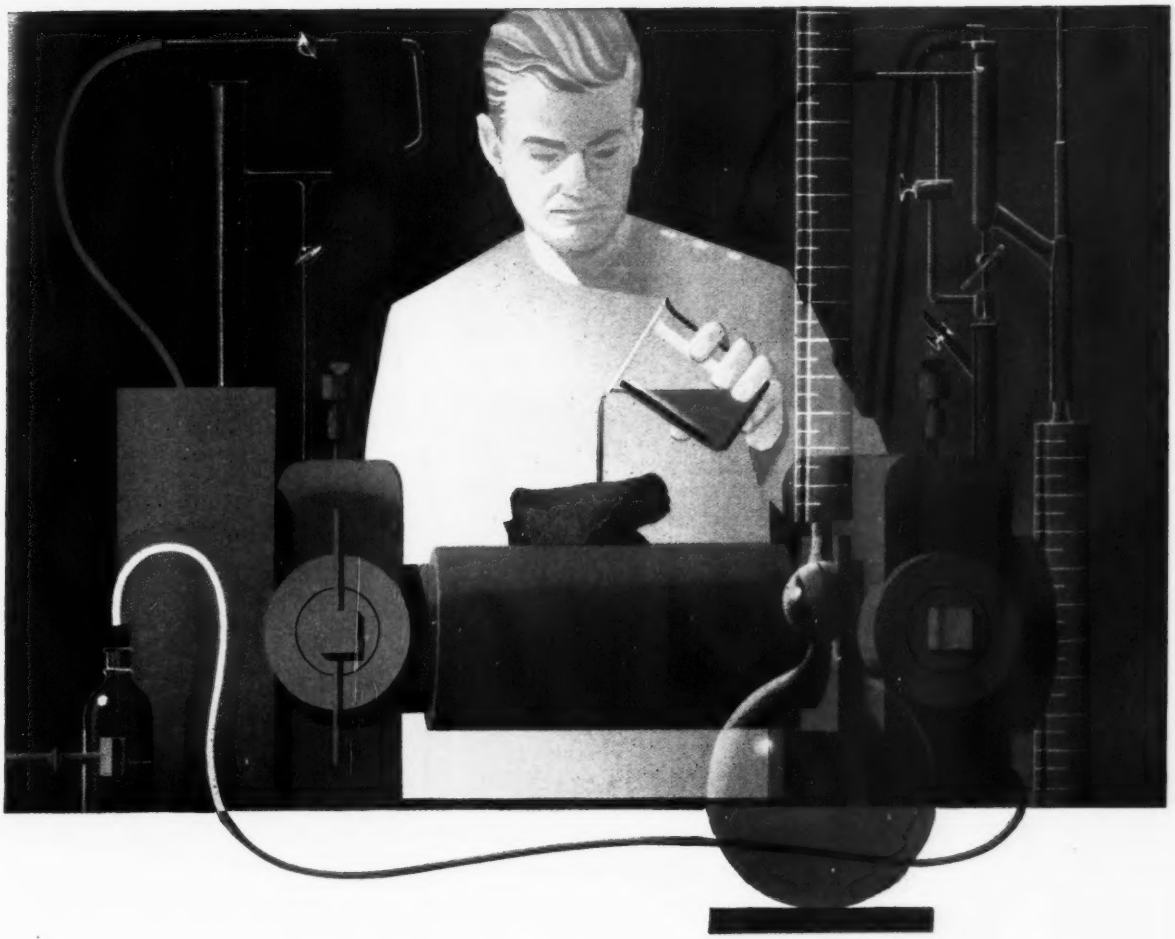

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If you are not already using Neville coumarone-indene resins in the manufacture of your rubber products, it will pay you to request the assistance of our Technical Service Laboratory. Our chemists will work with yours in choosing the exact grade to suit your need. Neville coumarone-indene resins are ideal extender-plasticizers. They aid processing and add tensile strength and durability to finished compounds. Write for details.

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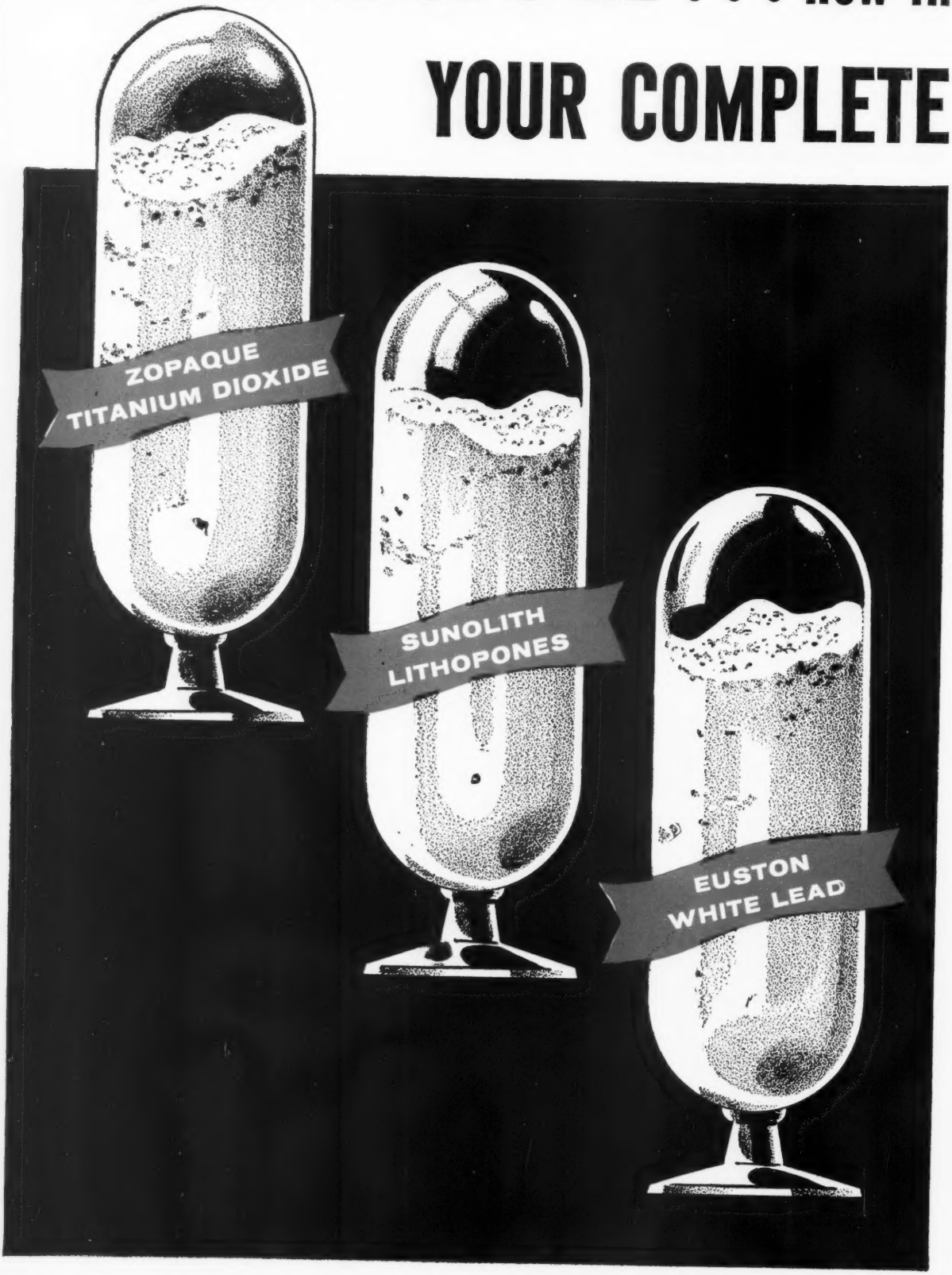

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WHITE PIGMENT NEEDS!

One source can meet your complete white pigment requirements. Specify Glidden, supplier of these pigments to industry: ZOPAQUE Titanium Dioxide, SUNOLITH Lithopones and EUSTON White Lead. These three pigments meet practically all formulations for plastic, paint, rubber, paper and ceramic products. Continuing Glidden expansion and modernization now make it possible to produce greater supplies of pigments than ever before!

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CHEMICALS—PIGMENTS
METALS DIVISION

QUALITY Glidden PRODUCTS

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COLLINSVILLE, ILLINOIS
HAMMOND, INDIANA
SCRANTON, PENNSYLVANIA

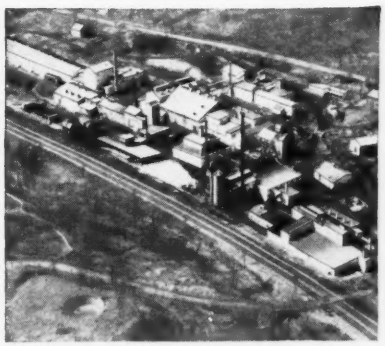
ZOPAQUE TITANIUM DIOXIDE

Production doubled; further expansion underway

The new Adrian Joyce Works, Baltimore, means doubled production of ZOPAQUE—the whitest white pigment obtainable. In ZOPAQUE, Glidden research has achieved greater whiteness and an accelerated dispersion rate plus outstanding gloss and color retention, low reactivity. Rutile and Anatase grades.

SUNOLITH LITHOPONES

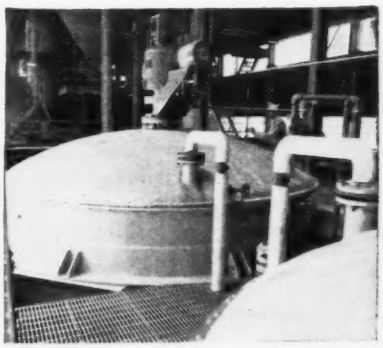
Modernized plant facilities increase efficiency



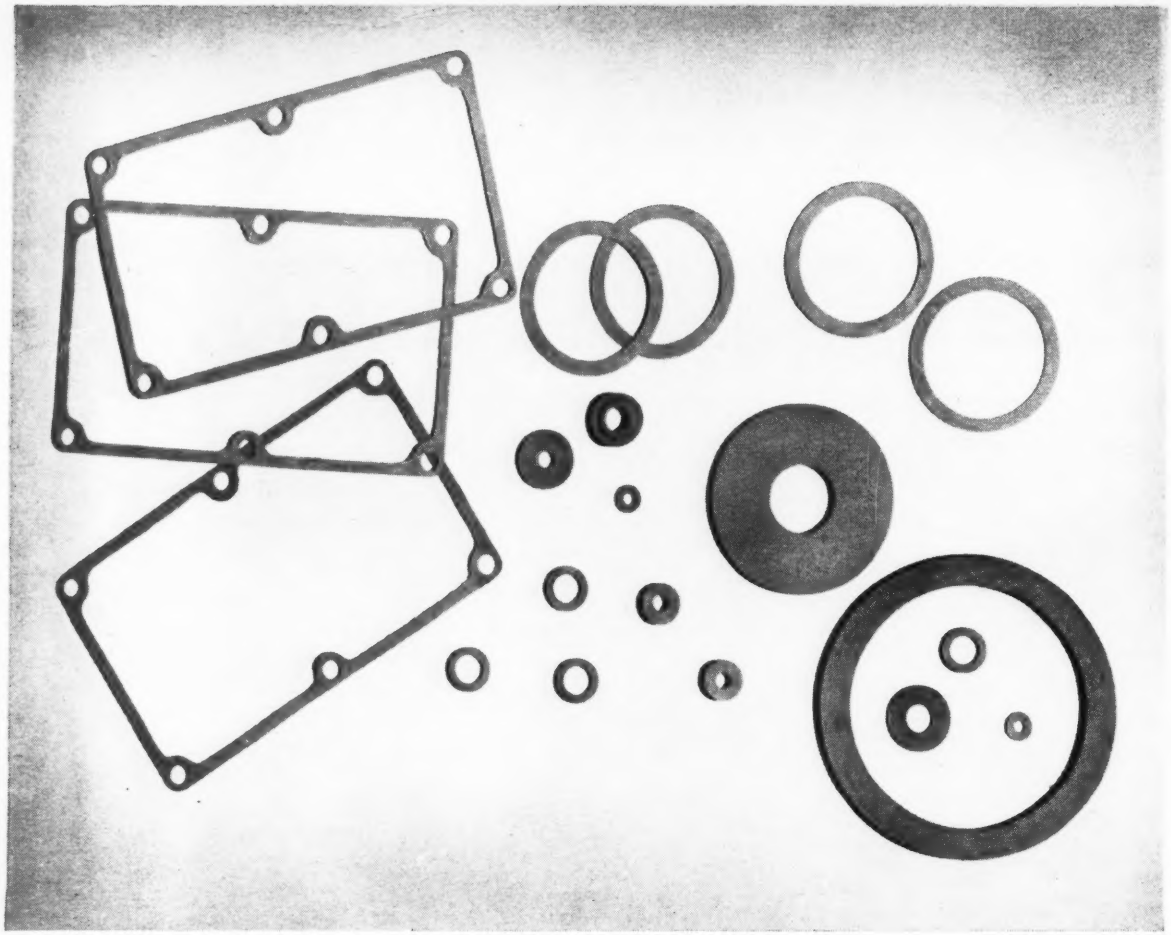
Improved facilities and processing efficiency at its Collinsville, Illinois plant, enable Glidden to meet the steady demand for SUNOLITH Lithopones . . . available in a wide range of grades, including Titanolith (titanated lithopone) with higher hiding value than regular lithopones.

EUSTON WHITE LEAD

Highest quality basic lead carbonate available



Continuous research and development at Euston Lead Division, Scranton, Pennsylvania, produce white lead of highest purity and quality. EUSTON White Lead has lower oil absorption than other white pigments. Finer, more uniform particles assure rapid solution, exceptional suspension. Various grades.



SEALS OR GASKETS—Products that must display outstanding resistance to compression set, perform better when Hercules Di-Cup—the new "cure-all" for polymers—is used as the curing agent.

DI-CUP* FOR TOP RESISTANCE TO COMPRESSION SET

Wherever low compression set, good aging, and good low-temperature properties are required, versatile new Hercules Di-cup (dicumyl peroxide) is the ideal curing agent.

Seals and gaskets, however, are only one of the many categories of products for which this nonsulfur vulcanizing agent has an indicated usefulness.

By producing carbon-to-carbon cross linking, Di-cup can be used to advantage as a curing agent in natural rubber, GR-S, Buna N, silicones, polyethylene and many other polymers.

Economical to use, Di-cup is a stable peroxide of low volatility. In addition to producing vulcanizates having low compression set, good aging, and resistance to solvents and oils, Di-cup enables you to produce whiter white stocks which have good color retention. Silicones in thick cross section cured with Di-cup are free of gas bubbles and acidic by-products.

To learn more about this nonsulfur curing agent, write to Hercules. We'll be glad to send you technical data and information on currently available commercial forms.

** Hercules trademark*

Oxychemicals Division, Naval Stores Department

HERCULES POWDER COMPANY

INCORPORATED

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N056-2

They thought it was alive

When Columbus and his sailors visited South America, they saw Indians playing with balls that bounced with such resilience the startled Europeans thought they were alive.

Those strange jumping balls, of course, were rubber. But rubber is no longer a plaything. It's so essential that rubber plantations—American style—have sprouted up throughout the country. One of the largest and best equipped of these domestic rubber plantations flourishes at Torrance, California, where Shell Chemical produces a full line of S-type copolymers to fill the needs of large and small Western manufacturers. You'll find that Shell synthetic rubber, available in a variety of solid types and liquid latices, can do a better job for you.

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Think of Torrance, California, whenever you need synthetic rubber. Our new phone number in Los Angeles is FAculty 1-2340.

SHELL CHEMICAL CORPORATION

Synthetic Rubber Sales Division
P. O. Box 216, Torrance, California

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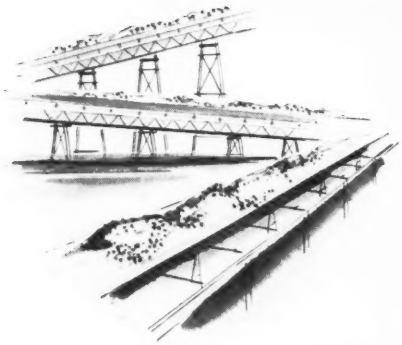

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Allied Chemical's caprolan® tensile-tough nylon

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OFFER UNUSUAL TOUGHNESS AND LONG FLEX LIFE IN HEAVY-DUTY INDUSTRIAL FABRICS

Caprolan *tensile-tough* nylon heavy yarns (2000 denier and up) are a completely new yarn class that assures unusual durability and economical performance in such industrial products as duck, webbing, rope and similar constructions.

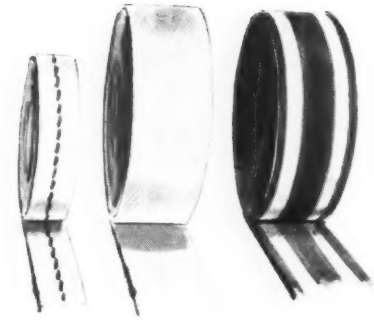
For heavy-duty applications, this new kind of nylon combines toughness, high impact strength, abrasion resistance, long flex life, and – for conveyor belts – excellent troughing qualities.

Where color is desired in nylon, Caprolan also offers a previously unavailable affinity for virtually any class of dyestuff, and can provide quality color rendition of dyes in shorter dye cycles.

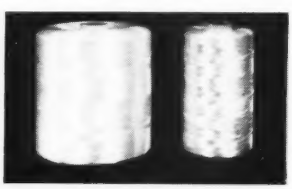
Caprolan nylon heavy yarns eliminate the need to ply multiple ends of finer deniers to achieve a higher total effect. They can be engineered as high as 50,000 total denier, according to your specifications, and are put up on a new 30-lb. package as well as on 10-lb. packages.

You will want to look into such Caprolan economies as longer runs between creelings . . . ready dyeability . . . elimination of costly fine denier inventories . . . and the unusual and lasting whiteness of Caprolan that develops no appreciable yellowing in storage.

Caprolan heavy yarns already have been established in many leading mills. For more information or technical assistance, call or write us today.



Webbing



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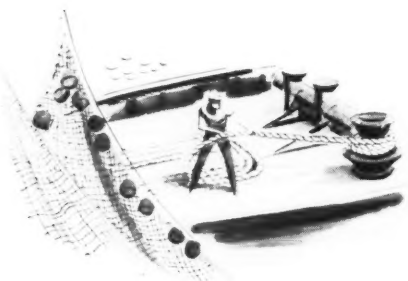

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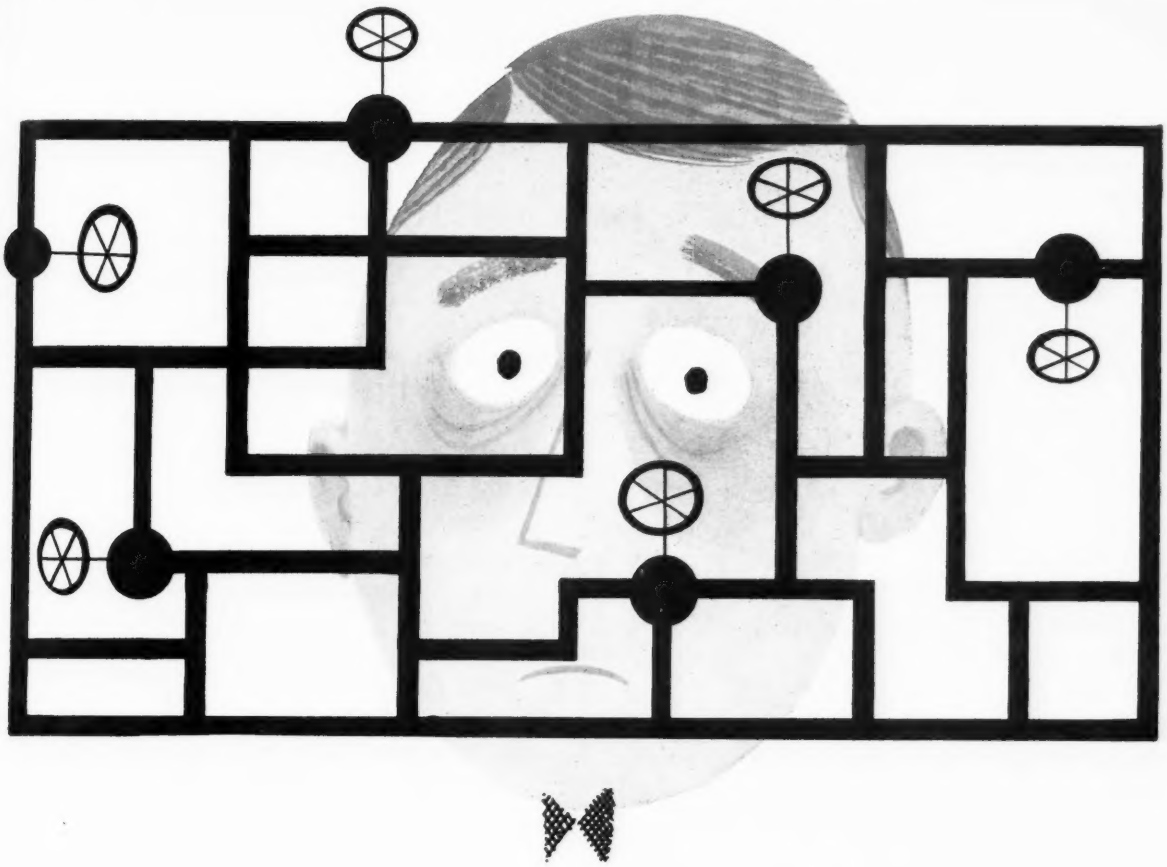
Branch Offices—Jefferson Standard Building, Greensboro, N. C., 200-204 S. Front St., Phil. 6, Pa., 15 Westminster St., Providence 3, R. I.

Processing Problem?



try **Velsicol** *hydrocarbon resins*

If processing worries follow you home and haunt you, it's time you had a chat with your Velsicol Representative. He's a qualified chemist, who can explain how manufacturers of rubber compounds have improved calendering, milling and curing characteristics with Velsicol Hydrocarbon Resins. He can supply samples for trial work, and acquaint you with the services of the Velsicol Resins Laboratory. Contact him soon. There's no obligation involved—just opportunity.

Look for this man!

... your Velsicol Representative, a qualified chemist who can show you how to make better rubber products at lower cost with Velsicol Hydrocarbon Resins.

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Bonds

A Koppers chemical you're sure to know is resorcinol. It assures the best possible adhesion between fabric and rubber in heavy-duty belts and hose, as well as all types of tires. In addition, it makes a possible oxidation inhibitor for rubber goods. Chemical reactions of resorcinol include alkylation, halogenation nitration, acylation, and aldehyde condensation. Other possible uses are described in Koppers Technical Bulletin on Resorcinol. Send for it.

Improvement

Divinylbenzene is another Koppers chemical that may have value for you. It now is used to improve the calendering, molding, and extruding characteristics of certain synthetic rubbers. It also can be used to make synthetic rubbers with special and useful properties when it is copolymerized with styrene and vinyl derivatives, as well as many other organic chemicals. Get more information in Koppers Technical Bulletin on divinylbenzene.

dbpc,® antioxidant made by Koppers, is an excellent non-staining rubber antioxidant for white wall tires, gloves, etc. And Koppers mono-tert-butyl-meta-cresol is a raw material for another superior non-staining antioxidant. Koppers Technical Bulletins on these products give full details.

And where can you use Koppers catechol? Its principal application in rubber chemistry now is as a vulcanizing agent in chloroprene elastomers, especially for the vulcanization of such elastomers in the form of froth sponge. Koppers Technical Bulletin on catechol may give you ideas for other uses.

Now

Call the nearest Koppers sales office, or write for complete information about *all* the quality Koppers chemicals that can help you. And remember: our research people, our engineers, and our sales representatives are able and anxious to help you in any way that you need help. Koppers Company, Inc., Chemical Division, Pittsburgh 19, Pennsylvania.

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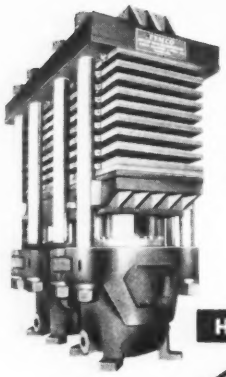

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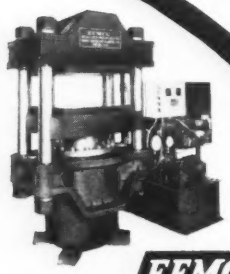

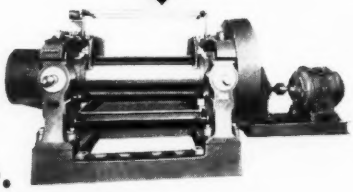

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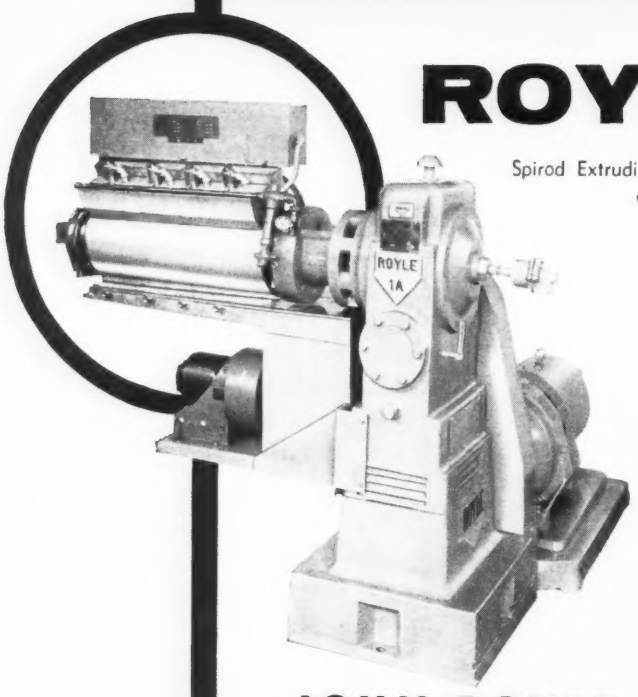

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New liquid polysulfide polymer assures easy, uniform dispersion

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MOLDED ITEMS such as well pistons and high pressure force cups display outstanding resistance to heat aging when compounded with Thiokol's new VA-7.

Best of all, VA-7 provides all these advantages at a surprisingly moderate price.

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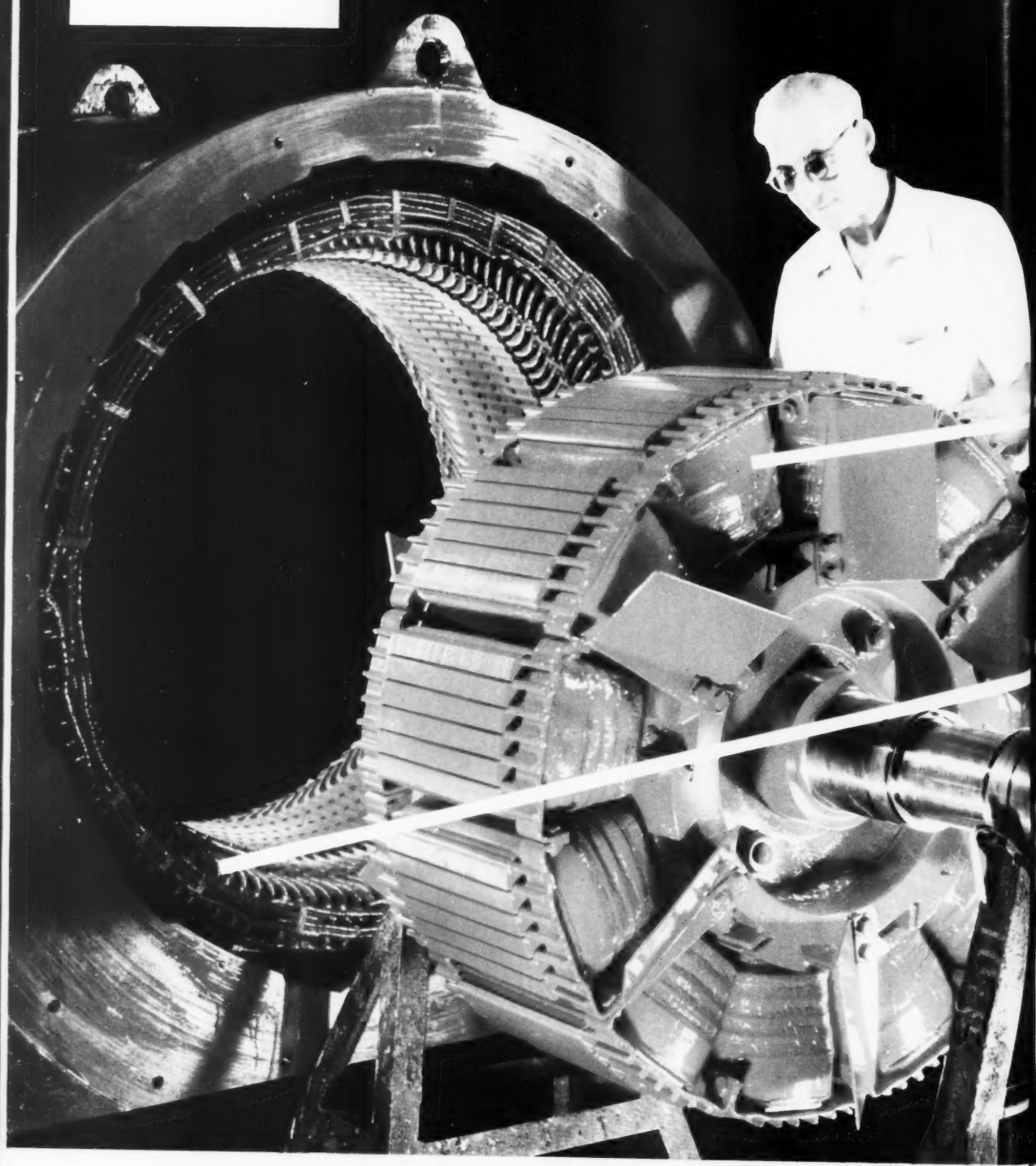

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Integrated Field Coils are bonded in heat-stabilized resins, enclosed in a resin-impregnated sheath of oriented glass fibers and bond-locked on the pole structure . . . dimensionally stable to withstand heating and thermal shock, vibration and fatigue at elevated temperatures . . . sealed throughout against atmospheric contaminants and fully protected against destructive forces.

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Exclusive Allis-Chalmers "double protection" is available on large electrical machines with operating temperatures through Class B range.

Silco-Flex is an Allis-Chalmers trademark.

For more information on these quality insulation systems contact your nearby A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin for Integrated Field Coil Bulletin 05R8525 and *Silco-Flex* Insulation Bulletin 05R8341.

Allis-Chalmers "Double Protection," with integrated field coils and Silco-Flex stator coil insulation, adapts this 600-hp, 2300-volt, 600-rpm synchronous motor to the most severe operating conditions.

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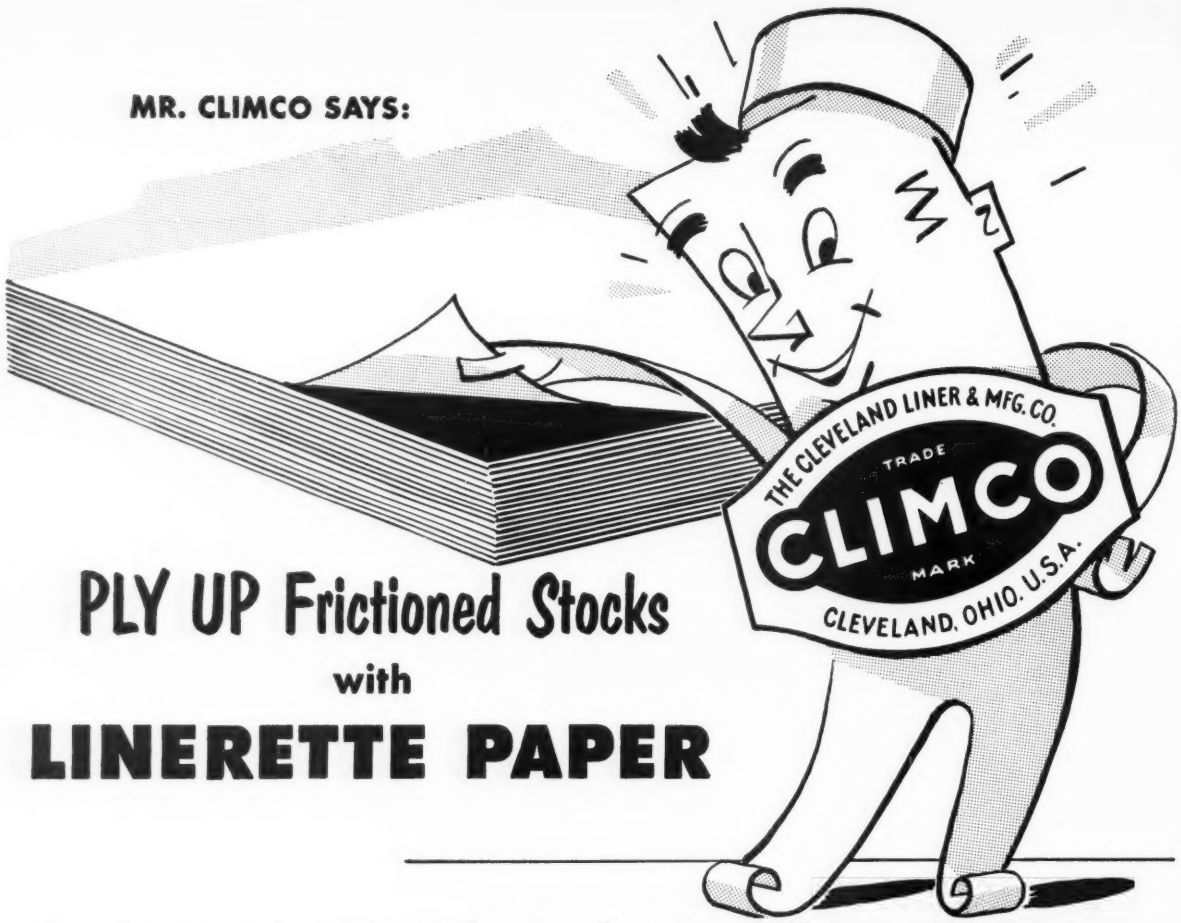

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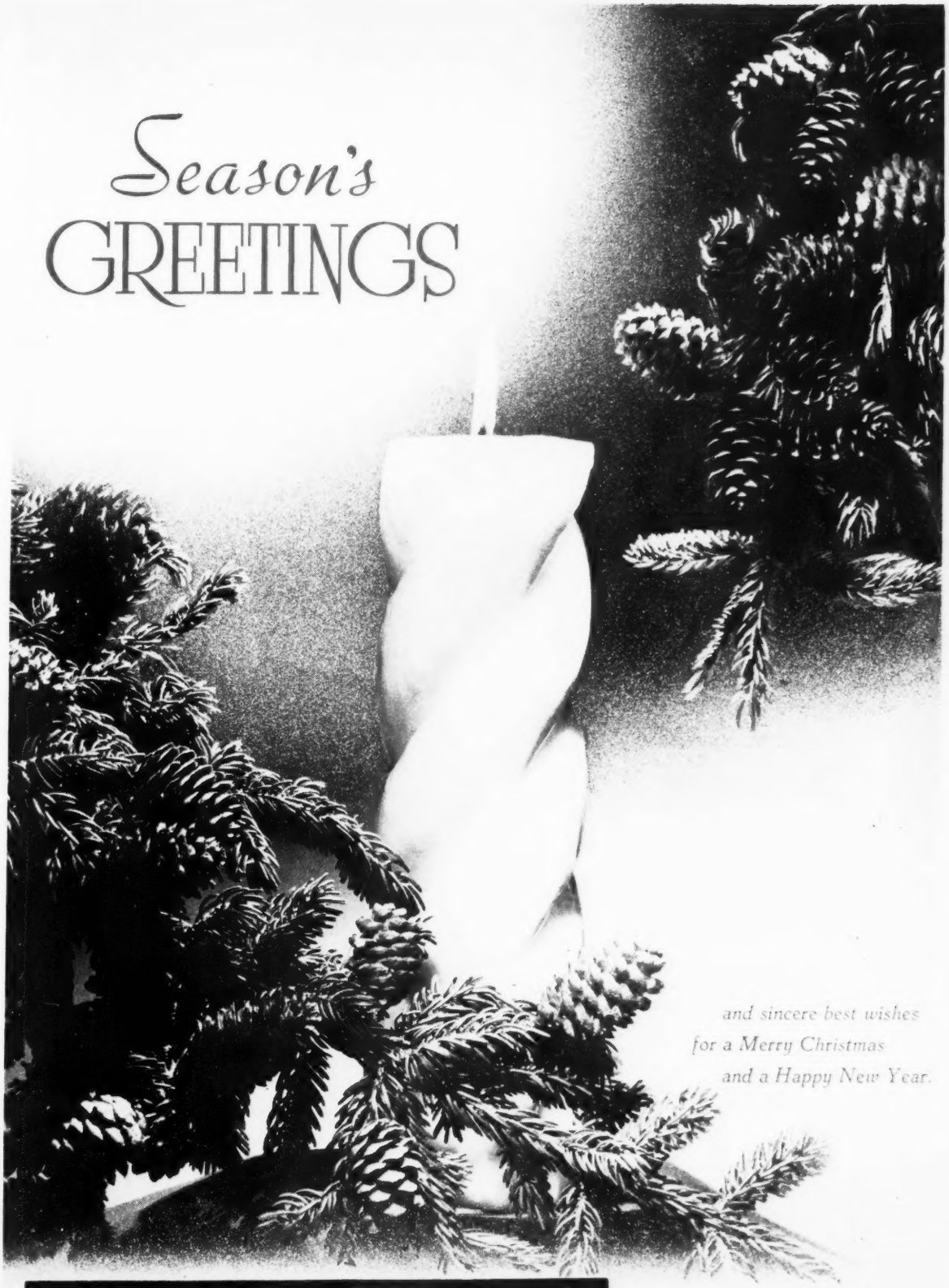

and sincere best wishes
for a Merry Christmas
and a Happy New Year.

Burgess Pigment COMPANY

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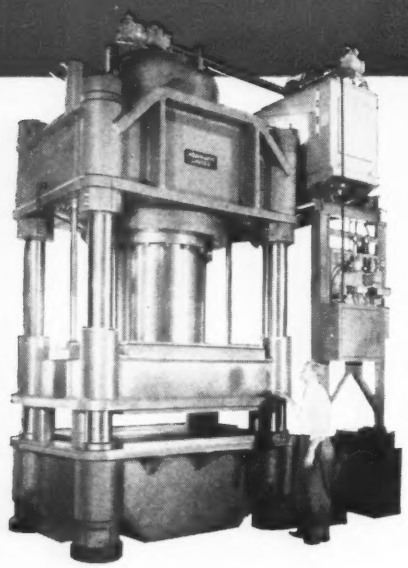
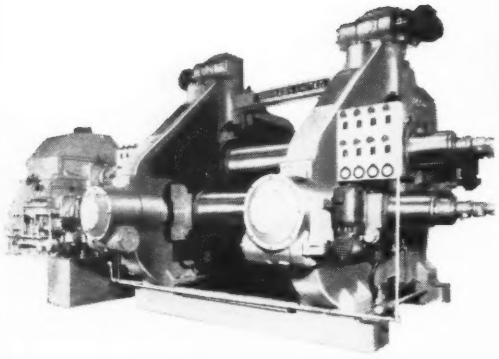
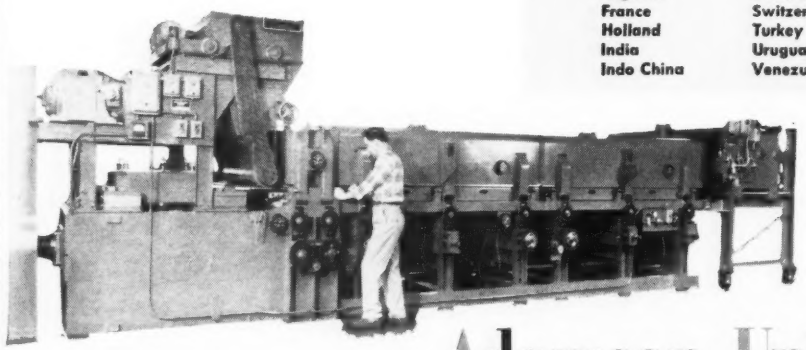


1450 Ton Hydraulic Press



28" x 78" Four-Roll Z-Type Calender



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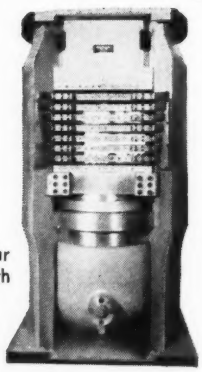

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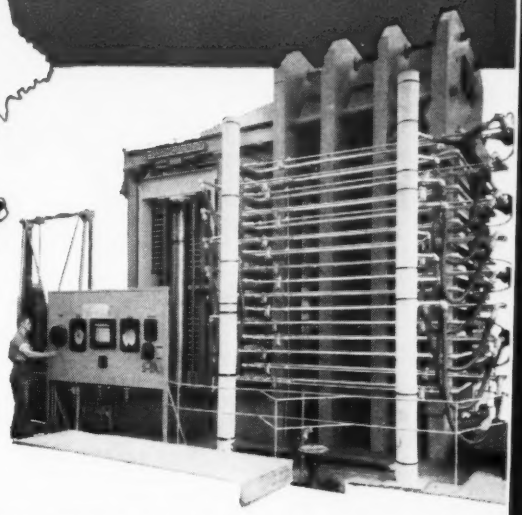

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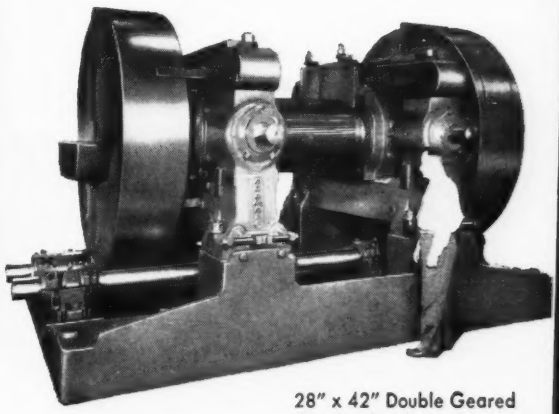

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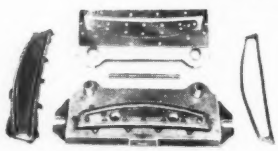

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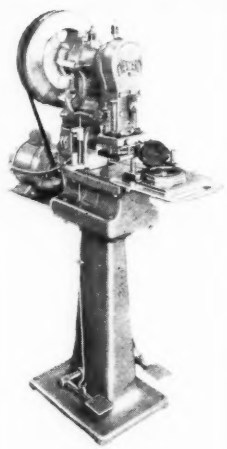

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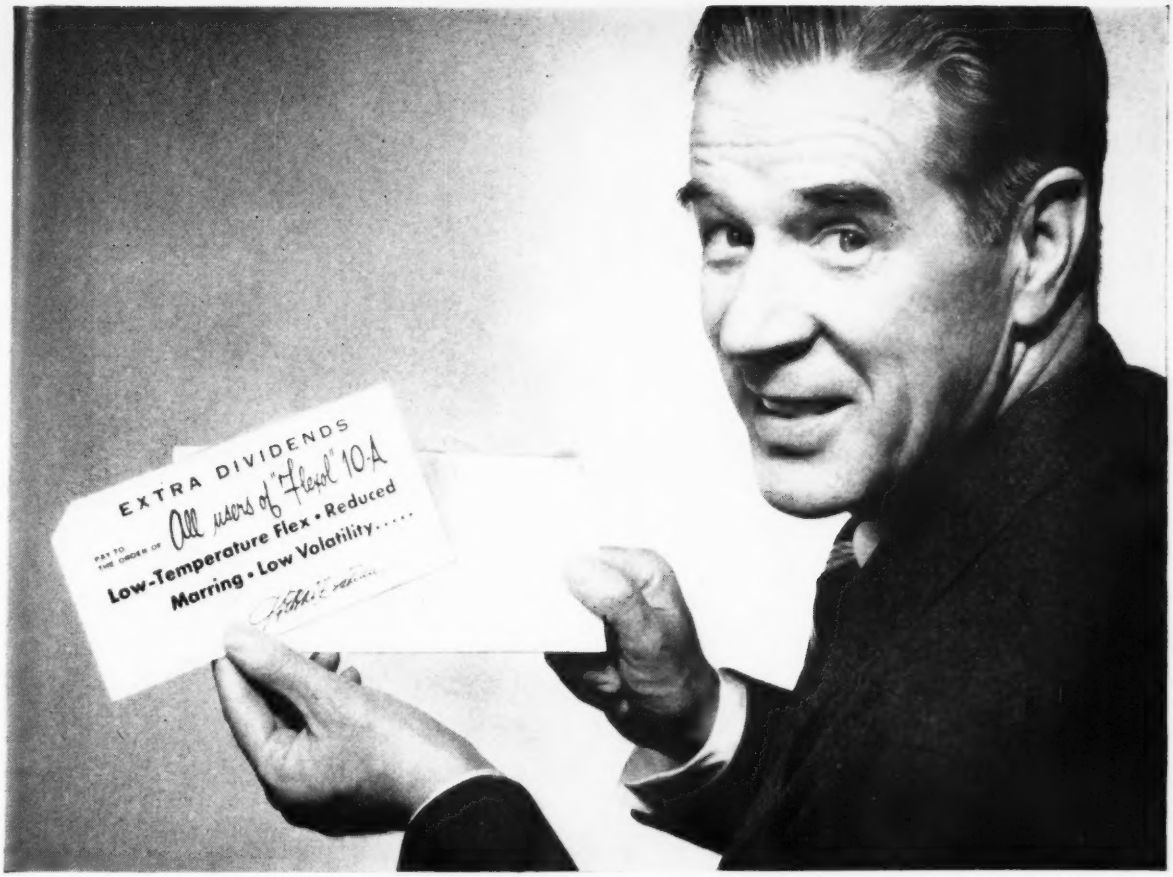

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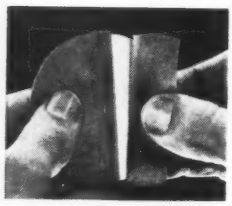

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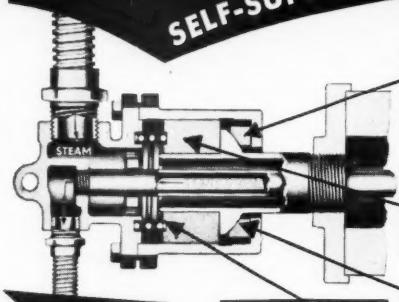

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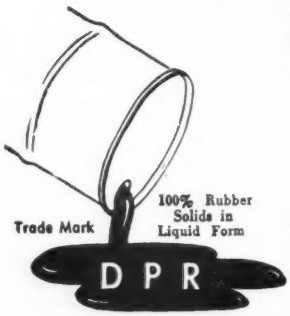

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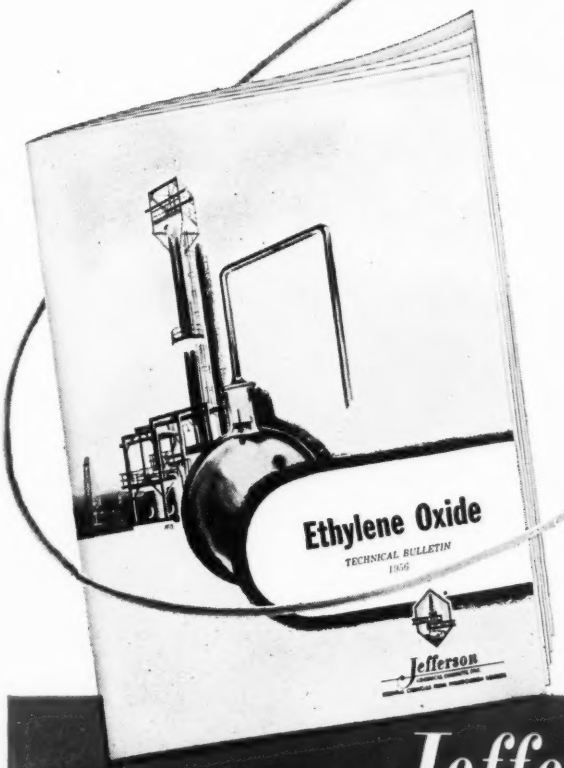

Jefferson's new technical bulletin on Ethylene Oxide presents data which you will find both interesting and helpful. This 44-page comprehensive bulletin covers: chemical and physical properties, specifications, analytical procedures, industrial uses, handling and storage, shipping information, engineering and operation of a typical batch reaction, container description, and toxicity. An extensive bibliography is also included.

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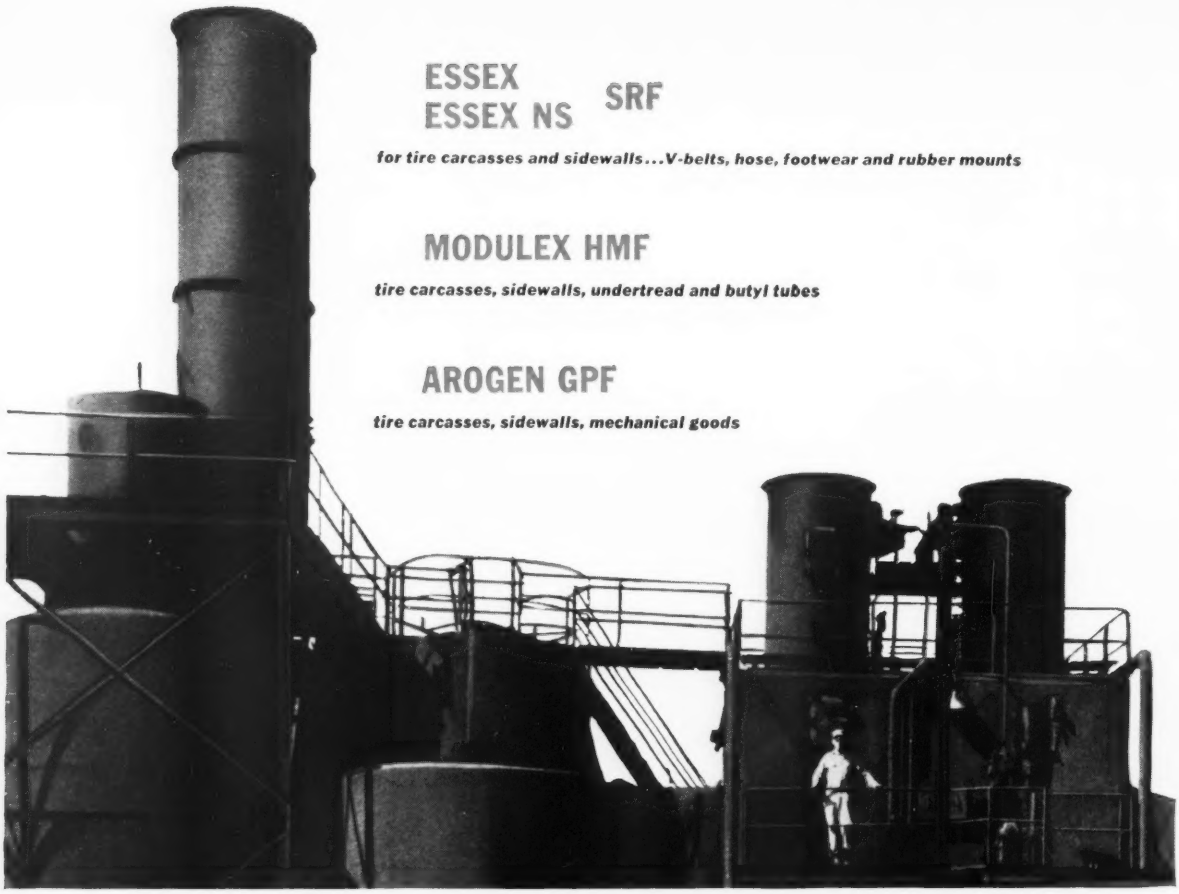

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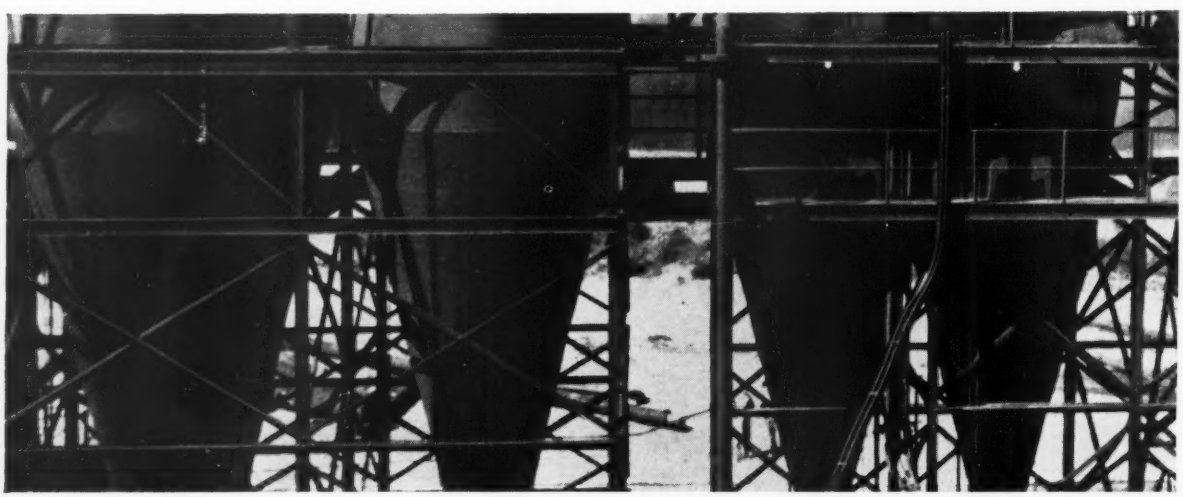

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DECEMBER, 1956

VOLUME 135, NUMBER 3

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H. M. Leeper, C. L. Gable, J. J. D'Amico, C. C. Tung

A new means of improving the properties of butyl rubber vulcanizates by chemical modification of the polymer has been devised. The reaction can be carried out in the Banbury mixer at conventional times and temperatures.

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RUBBER WORLD
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Improved Resilience in Butyl Rubber Through Chemical Modification

By H. M. LEEPER and C. L. CABLE, J. J. D'AMICO
Monsanto Chemical Co., Dayton, O. *Monsanto Chemical Co., Nitro, W. Va.*

and C. C. TUNG
Monsanto Chemical Co., St. Louis, Mo.

A new means of improving the properties of butyl rubber vulcanizates by chemical modification of the polymer with N-methyl-N,4-dinitrosoaniline is presented.

The use of the modified polymer is advantageous in both black and non-black stocks and leads to improved resilience, increased 300% modulus, decreased hardness, improved low-temperature properties, increased electrical resistivity, and better processing characteristics.

The reaction can be carried out in a Banbury mixer under normal conditions of operation, and chemical modification of butyl rubber has been demonstrated successfully on a plant scale.

THE relatively low chemical unsaturation of the butyl rubber molecule has long provided an incentive to rubber compounders to utilize this property for the resistance it contributes to degradation by heat, light, oxygen, and ozone. Unfortunately this low unsaturation has been a limiting factor in development of the proper balance of physical properties in butyl rubber vulcanizates for satisfactory performance in applications where heavy dynamic work is imposed upon the rubber part; for example, in tire service.

This paper discusses a new approach toward improving the properties of butyl rubber vulcanizates: namely, that of chemical modification of the butyl polymer by a substituted polyfunctional aromatic amine. This chemical modifier is N-methyl-N,4-dinitrosoaniline and is currently available in 33⅓% active mixture with inert filler under the trade mark Elastopar.[1] The use of Elastopar modifier in butyl rubber leads to greatly improved resilience and associated properties, increased 300% modulus, decreased Shore hardness, enhanced processing characteristics, improved low-temperature properties, and increased electrical resistivity of several orders of magnitude.

The past three years have witnessed some remarkable advances in the technology of processing butyl rubber by virtue of work reported by Gessler and coworkers[2-6] on promoted heat treatment of mixtures of butyl rubber with carbon black and silica, respectively. Butyl rubber vulcanizates with greatly improved resilience were produced by repeated cycles of heating and remilling or by prolonged mastication of the butyl-carbon black masterbatch.

Two promoters for the heat-influenced interaction between polymer and carbon black were proposed, sulfur and *p*-dinitrosobenzene. The processing involved: (a) mixing of the carbon black and promoter into the polymer under conditions which produce good dispersions; (b) Banbury mastication of the resulting mix-

[1]Elastopar—A trade mark of Monsanto Chemical Co., St. Louis, Mo.
[2]A. M. Gessler, *Rubber Age (N. Y.)*, 74, 59 (1953).
[3]R. L. Zapp, A. M. Gessler, *Ibid.*, 74, 243 (1953).
[4]A. M. Gessler, F. P. Ford, *Ibid.*, 74, 397 (1953).
[5]J. Rehner, A. M. Gessler, *Ibid.*, 74, 561 (1954); 77, 875 (1955).
[6]A. M. Gessler, H. K. Wiese, J. Rehner, *Ibid.*, 78, 73 (1955).

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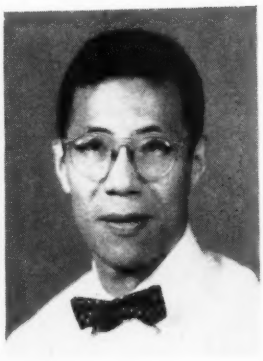

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tures for 10-30 minutes at 300-400° F.; and (c) completion of compounding and vulcanizing in accord with customary factory practice. Certain disadvantages are inherent in these conditions. The use of *p*-dinitrosobenzene involves a lengthy mixing cycle. The promoter itself, moreover, has a well-known tendency to form cross-links between butyl polymer chains; this can be an undesirable side reaction, affecting adversely the processibility of the resulting mixed stock.

This currently reported work discusses data which attest to the effectiveness of Elastopar in improving the properties of butyl rubber vulcanizates without the accompaniment of decreased processibility. Reaction can be carried out in a Banbury mixer under normal conditions of operation and, indeed, has been demonstrated successfully on a plant scale.

Experimental Techniques

Elastopar modifier operates best if allowed to react for a short time (one minute on the laboratory scale) with the raw butyl rubber in the Banbury mixer; carbon black and vulcanizing ingredients are then incorporated in conventional fashion. This procedure was followed for most of the studies reported here. Alternative Banbury procedures which are also effective involve introduction and reaction of the additive following blending of carbon black with butyl rubber or adding the modifier and black simultaneously to the butyl polymer. Any of these could be practical procedures in plant operation.

It is also possible to obtain comparable improvement in properties if the modified polymer be prepared by

dispersion of the additive in raw butyl rubber on the mill, followed by static oven heating of the butyl-modifier mixture to effect reaction.

A considerable part of the experimental work consists of studies of the use of this new modifier at various concentrations (0.0-3.0 parts/100 butyl rubber) in recipes containing 50 parts of medium processing channel black or high abrasion furnace black, respectively. In the investigation of other variables, a reinforcing system consisting of a 35/15 mixture of MPC and HAF blacks was used.

Unless otherwise indicated, compounding recipes, mixing techniques, and curing conditions are as shown in Table 1. Total Banbury mixing time for modification of the butyl rubber and incorporation of the carbon black was arbitrarily set at 10 minutes for a considerable portion of the work described. This choice of cycle was made and used prior to a study which explored variations in times of mixing. That a 10-minute period is longer than necessary is demonstrated by the data in Table 5.

Processing and testing equipment, as well as procedures followed, are listed in Table 2.

Table 1. Basic Recipe and Mixing Conditions

Enjay Butyl* 217	100.0	Add to preheated Banbury—300° F. Mix 1 minute
Elastopar	0.0-3.0	
Carbon black	50.0	Mix 9 minutes/300° F.
Stearic acid	1.0	
Zinc oxide	5.0	Mix on mill/122° F.
Thiofide†	1.0	
Thiurad‡	1.0	
Sulfur	2.0	
Cure 45 min./307° F.		

* Enjay Butyl—A registered trade mark of Enjay Co., Inc.
† Thiofide—A registered trade mark of Monsanto Chemical Co. (Benzothiazyl disulfide.)
‡ Thiurad—A registered trade mark of Monsanto Chemical Co. (Tetramethylthiuram disulfide.)

Table 2. Test Methods and Conditions of Evaluation

Operation or Test	Conditions
Banbury mixing	#00 Banbury
Mill mixing	6 x 12 mill—roll speed ratio, 1.4:1
Mooney viscosity	Large rotor—4 minutes running time at 212° F., ASTM D927-53T*
Mooney scorch	Total running time to reach a viscosity of 10 points above minimum value at 275° F., ASTM D1077-49T*
Stress-strain	ASTM D412-51T*
Torsional hysteresis	As described by Mooney and Gerke[7]—tests run at 77° F.
Hardness	Shore A durometer—ASTM D314-52T*
Goodrich flexometer	1800 cpm., 17.5-inch stroke, 175 psi. load, ambient temperature, 212° F., ASTM D623-41T*
Yerzley oscillograph	As described by Baldwin[8]
Electrical resistivity	Vibrating reed electrometer, Model 30, Applied Physics Corp. (unpublished method).
Low-temperature	Clash-Berg method, ASTM D1043-51*

*American Society for Testing Materials, Philadelphia Pa.

Experimental Results

Modifier Concentration

Table 3 describes the changes in stress-strain, Shore hardness, Mooney viscosity and scorch time, torsional hysteresis, and Goodrich flexometer data as the concentration of Elastopar is varied over the range of 0.0-3.0 parts. It is striking that, in general, substantial increases in 300% modulus are accompanied by simultaneous decreases in Shore hardness. Optimum modulus and hysteresis properties are developed with a concentration range of 1.2-1.8 parts Elastopar modifier /100 butyl rubber. There are no distinct trends in tensile strength, but the modified stocks generally show reduced ultimate elongations. A plot of 300% modulus *versus* time of cure in Figure 1 furnishes additional confirmation of the important changes which have taken place in the butyl polymer.

The use of an additive which increases 300% modulus 1½- to two-fold over that of the control might well be expected to introduce scorching problems.

Table 3. Properties of Butyl Rubber Stocks Versus Concentration of Modifier

	Parts Elastopar /100 Butyl Rubber					
MPC Black	0.0	0.6	1.2	1.8	2.4	3.0
Mooney viscosity (ML-4/212° F.)	95	89	94	102	100	91
Mooney scorch (min. to I+10) @ 275° F.	17	20	22	21	21	21
300% Modulus (psi)	1400	1800	1930	2000	1930	1980
Ultimate tensile strength (psi.)	3150	3080	3150	3000	2790	2750
Elongation (%)	560	460	450	420	410	400
Hardness (Shore A)	67	64	60	62	60	64
Torsional hysteresis (logarithmic decrement) @ 77° F.	0.404	0.247	0.174	0.166	0.176	0.174
Goodrich flexometer data @ 212° F.						
Dynamic drift (%)	17.7	14.4	14.1	13.6	14.8	16.4
Permanent set (%)	20.6	16.6	15.4	16.4	16.7	19.5
Heat rise (°F.)	47	38	36	36	40	41
HAF Black						
Mooney viscosity	93	85	90	75	82	84
Mooney scorch	17	19	18	20	17	16
300% modulus	1590	2160	2440	2350	2410	2540
Ultimate tensile strength	2240	2600	2630	2550	2730	2540
Elongation	410	380	340	350	350	300
Hardness	74	74	70	70	69	74
Torsional hysteresis	0.397	0.322	0.239	0.215	0.186	0.263
Goodrich flexomater data						
Dynamic drift	17.3	14.4	12.6	15.7	12.4	22.4
Permanent set	20.2	18.0	14.6	18.3	15.8	24.7
Heat rise	47	43	38	43	38	58

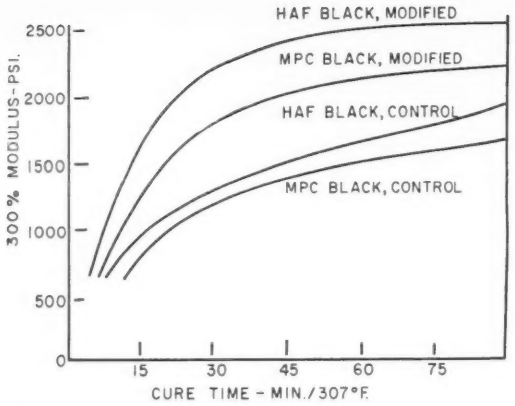

Fig. 1. Modulus *vs.* cure time for modified and control butyl stocks

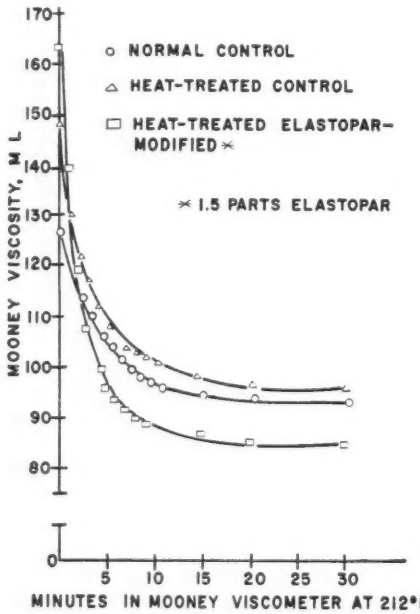

Fig. 2. Mooney viscosities of normal, heat treated, and heat treated-Elastopar modified, HAF/MPC butyl rubber stocks

The data show that on the contrary this modifier effects an increase of 3-4 minutes in scorch time. Mooney viscosities of the fully compounded MPC black stocks are somewhat erratic, but those of the HAF stocks are definitely decreased as a result of chemical modification.

Figure 2 demonstrates Mooney viscosity behavior of a 35/15 MPC/HAF black system. The viscosity of the modified stock quickly drops several points below the values of the control stocks in the course of the viscosity measurement, although originating at a higher level. The lower equilibrium plasticity of the modified stock is the criterion of its enhanced processibility over that of the controls.

Table 3 illustrates also the effects of modifier concentration upon resilience, as measured under conditions of free torsional vibration. This work differs somewhat

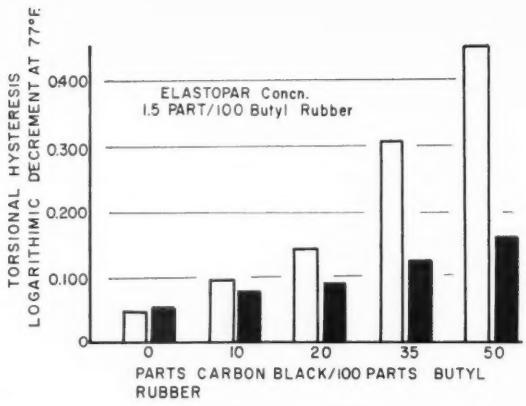

Fig. 3. Effectiveness of modifier *versus* concentration of carbon black. Black bars give results for modified stocks; unshaded bars represent stocks without modifier

from the work of Mooney and Gerke[7] in that determinations were run at room temperature (77° F.) rather than at elevated levels. Consequently, somewhat higher values were obtained in the data which are reported here than would be obtained at higher temperatures. From these determinations it is again apparent that optimum properties are achieved in the range of 1.2-1.8 parts of Elastopar/100 parts butyl rubber.

The Goodrich flexometer data point to progressive decreases in hysteresis with increasing concentration of Elastopar, reaching an optimum level in the range of 1.2-1.8 parts modifier.

Modification Temperature

The action of the modifier is observed to be strongly dependent upon temperature of reaction. The results shown in Table 4 were obtained with 1.5 parts of the modifier per 100 parts of Butyl rubber, employing a 35/15 mixture of MPC/HAF black at the 50-part level. Temperatures of Banbury modification were varied over the range of 170-390° F.; the respective temperatures were then maintained throughout incorporation of the carbon black. Optimum 300% modulus and torsional hysteresis properties are reached at a mixing temperature as low as 255° F.

Mixing Cycle Time

The data in Table 5 show that optimum modulus and hysteresis properties are gained with a total Banbury mixing time as short as 2-3 minutes including a one-minute period of chemical modification.

Particularly striking is the comparison of properties of the blank control, which was mixed for 10 minutes, with those of the modified stocks, which were mixed for shorter times. These results are indicative of the speed with which the modifier reacts to produce markedly improved properties.

Modification at Various Carbon Black Loadings

A commonly observed phenomenon in butyl rubber

[7] *Rubber Chem. Tech.*, 14, 35 (1941).

Table 4. Temperature of Banbury Modification and Mixing with Carbon Black

[Variation Banbury Modification Temperature (35/15 MPC/HAF Black Stocks)]

	Mixing Temperature °F.						
	300*	170	210	255	300	345	390
Stress-Strain							
M_{300} (psi.)	1670	1700	1970	2130	2240	2280	2380
Torsional Hysteresis							
Logarithmic decrement @ 77° F.	0.426	0.250	0.282	0.197	0.196	0.175	0.175
Goodrich Flexometer							
Dynamic drift, %	19.1	24.9	20.7	13.8	13.6	10.0	10.2
Permanent set, %	21.8	25.1	22.8	15.5	13.6	11.1	12.5
Heat rise, °F.	50	50	50	36	34	29	31

*Blank control.

Table 5. Time of Banbury Modification and Mixing with Carbon Black

[Variation Banbury Modification Time (35/15 MPC/HAF Black Stocks)]

	Total Mixing Time—Min./300° F.							
	10*	2	3	4	6	8	10	15
Stress-Strain								
M_{300} (psi.)	1700	2100	2290	2170	2220	2030	2200	2170
Torsional Hysteresis								
Logarithmic decrement @ 77° F.	0.412	0.203	0.176	0.185	0.174	0.150	0.178	0.177
Goodrich Flexometer								
Dynamic drift, %	17.9	15.4	13.8	14.9	13.9	13.0	13.0	14.0
Permanent set, %	20.4	15.5	16.0	16.3	14.8	15.6	15.8	15.9
Heat rise, °F.	47	43	36	38	36	34	36	36

*Blank control.

and in other elastomers is an increase in hysteresis with carbon black loading. It is demonstrated in Figure 3 that this effect is much less for Banbury-mixed MPC/HAF stocks in the presence of Elastopar. The magnitude by which the modifier reduces hysteresis is directly proportional to concentration of carbon black. These results imply an interdependence between chemical modification and pigment reinforcement.

Factory-Scale Evaluation

The work with the laboratory Banbury was extended to factory evaluation of chemical modification. A #11 Banbury was used under normal conditions of operation. Elastopar modifier was added to the mixer simultaneously with butyl rubber, carbon black, zinc oxide, and stearic acid. The recipe and procedure employed and the results derived are shown in Table 6. Laboratory evaluation of the same recipe is included for comparison.

Good agreement was obtained between laboratory and factory processing. The stress-strain data show a 1½-fold increase in 300% modulus for the factory and laboratory stocks over the unmodified factory stock. Dynamic modulus, as measured by the modified Yerzley oscillograph[8], is reduced by more than 25% in the laboratory run and 17.5% in the factory test. Similar improvements are obtained in relative damping and internal viscosity. Goodrich flexometer data greatly favor modified butyl rubber in both laboratory and factory tests.

The factory data indicate that laboratory results may be duplicated on a commercial scale and are a tribute to the effectiveness of the modifier at the modest concentration of 0.9-part (0.3-part active ingredient).

Table 6. Evaluation of Elastopar in Factory Equipment

	Laboratory	Factory	Factory*
Enjay Butyl 325	100.0	100.0	100.0
Elastopar	0.9	—	0.9
MPC black	40.0	40.0	40.0
Necton (†) 60	8.0	8.0	8.0
Stearic acid	0.5	0.5	0.5
Zinc oxide	5.0	5.0	5.0
Sulfur	1.5	1.5	1.5
Tellurac‡	1.0	1.0	1.0
Thiofide	1.0	1.0	1.0
Cure 40′/307° F.			
Stress-Strain			
300% Modulus (psi.)	1190	800	1200
Tensile strength (psi.)	2150	2140	2040
Ultimate elongation (%)	460	570	440
Yerzley Oscillograph			
122° F., 16 cps.			
Dynamic modulus (dynes/cm² x 10^{-7})	2.14	2.89	2.38
Relative damping (%)	32.3	40.0	31.1
Internal viscosity (poises x 10^{-6})	0.555	0.979	0.594
Goodrich Flexometer			
Permanent set (%)	11.0	23.0	15.3
Dynamic drift (%)	8.6	16.2	9.0
Heat rise, °F.	43	57	45

*Conditions of Banbury mixing:
0 minute —Charge butyl, carbon black, zinc oxide, stearic acid and Elastopar to #11 Banbury @ 40 rpm.
7 minutes—Temp. 340° F. Add Necton 60.
10 minutes—Dump. Temp. 350° F.
†Necton - A registered trade mark of Esso Standard Oil Co. (Mineral oil)
‡Tellurac - A trade mark of R.T. Vanderbilt Co. (Tellurium diethyl dithiocarbamate)

Order of Addition of Elastopar and Other Ingredients

As an alternative to incorporating the modifier into the raw butyl polymer and subsequently heat treating this system, it is also practicable to incorporate the additive into a butyl rubber-carbon black mixture and to react the system under either dynamic or static condi-

[8]F. P. Baldwin, *Rubber Age* (*N. Y.*) 67, 51 (1950).

Table 7. Comparison of Properties of HAF/MPC Black Stocks for Different Reaction Methods

	Control	Elastopar* Reacted with Gum Polymer	Elastopar* Reacted with Butyl/Carbon Black Mix
300% Modulus (psi.)	1460	2070	1900
Tensile strength (psi.)	2820	2680	2760
Elongation (%)	510	410	450
Logarithmic decrement @ 77° F.	.398	.159	.228

*Concentration: 1.5 parts/100 parts butyl rubber.

Significant improvements in modulus and torsional hysteresis also are obtained when Elastopar is incorporated into butyl rubber/carbon black mixtures and reacted under static conditions in a 300° F. oven. These data are described in Table 8.

Table 9 summarizes an experiment involving chemical modification with Elastopar in the presence of other ingredients of the recipe. No change in properties occurs as the result of incorporating zinc oxide plus stearic acid prior to chemical modification. The presence of accelerators influences modulus and torsional hysteresis: Thiofide intensifies the effect of Elastopar; while Thiurad diminishes its activity. The additions of sulfur, sulfur plus zinc oxide and stearic acid, or a combination of accelerators plus zinc oxide and stearic acid prior to the modification step cause a strong scorching effect during the Banbury operation and resultant impaired processibility of the stocks.

It has also been found that processing oil can be added prior to chemical modification without incurring adverse effects.

Table 8. Effects of Reacting Elastopar with Butyl/Carbon Black Mixes Under Static Conditions in an Oven

[Properties after Modification in Oven (HAF and MPC Black Stocks)]

		Masterbatches							
		Enjay Butyl 217 HAF Black 100 50				Enjay Butyl 217 MPC Black 100 50			
		1	2	3	4	5	6	7	8
Elastopar, phr		...	0.3	0.9	1.5	...	0.3	0.9	1.5
Properties of Vulcanizate	Oven Heating of Masterbatch, Hr./300° F.								
M_{300} (psi.)	0	1520	1910	1780	1720	900	1190	1290	1420
	4	1680	2000	2350	2440	1390	1470	1890	1840
Tensile (psi.)	0	2580	2900	2620	2600	3170	3180	3220	3170
	4	2650	2830	3030	3040	3280	3170	3330	3250
Elongation (%)	0	520	470	470	450	700	670	630	620
	4	490	460	400	410	650	590	510	480
Torsional hysteresis (log. decr. @ 77° F.)	0	0.45	0.38	0.31	0.30	0.44	0.37	0.29	0.27
	4	0.41	0.28	0.18	0.16	0.37	0.26	0.17	0.15
Mooney scorch	0	13.7	13.5	12.7	12.7	13.4	13.6	13.8	12.5
Min. 275° F. (l + 10)	4	16.6	17.3	19.8	19.8	17.5	17.5	17.0	18.3

NOTE: Addition of vulcanizing system and curing conditions are as described in Table 1.

Table 9. 300% Modulus and Logarithmic Decrement Values—Modification in Presence of Other Compounding Ingredients

Recipe:	
Enjay Butyl 217	100.0
Elastopar	1.5
HAF black	15.0
MPC black	35.0
Zinc oxide	5.0
Stearic acid	3.0
Thiofide	1.0
Thiurad	1.0
Sulfur	2.0

Heat treatment: 1′ @ 300° F., 10-minute total cycle in Banbury mixer

Cure: 45′/307° F.

Additives Present during Heat Treatment of Butyl Rubber	M_{300}	Logarithmic Decrement @ 77° F.
Elastopar	1950	0.203
Elastopar, zinc oxide, stearic acid	1860	0.201
Elastopar, Thiofide	1980	0.177
Elastopar, Thiurad	890	0.334
Elastopar, Thiofide, Thiurad	1240	0.267
Elastopar, zinc oxide, stearic acid, Thiofide, Thiurad	Scorched in the Banbury	
Elastopar, sulfur		
Elastopar, zinc oxide, stearic acid, sulfur		

tions. Table 7 shows that substantial improvements in modulus and torsional hysteresis are obtained under dynamic conditions in the Banbury mixer by this order of mixing. The results, particularly hysteresis, are not quite equal to those yielded by the modified-gum control stock, but still represent large improvement.

Elastopar in Butyl Vulcanizing Systems

The data in Table 10 show that the benefits which Elastopar modifier imparts to butyl rubber extend in significant degree to all the main types of vulcanizing systems which are conventionally used with butyl rubber. The GMF[9] and Dibenzo GMF[10] systems respond less vigorously to the action of Elastopar than do systems based upon Thiofide/Thiurad, Thiotax[11]/Thiurad, Tellurac, and Ethyl Selenac.[12]

[9]GMF—A trade mark of Naugatuck Chemical Division, United States Rubber Co. (*p*-Quinone dioxime).

[10]Dibenzo GMF—A trade mark of Naugatuck Chemical (*p*-Quinone dioxime, dibenzoate).

[11]Thiotax—A trade mark of Monsanto Chemical Co. (2-Mercaptobenzothiazole).

[12]Ethyl Selenac—A trade mark of R. T. Vanderbilt Co. (Selenium diethyldithiocarbamate).

Table 10. Elastopar in Various Butyl Rubber Vulcanization Systems

		Base Stocks		Normal Control	Heat Treated Control	Heat Treated Elastopar Modified
		Enjay Butyl 217		100	100	100
		HAF black		15	15	15
		MPC black		35	35	35
		Temperature of Banbury mixing, °F.		212	300	300
			Min. Cure @ 307° F.			
1.		Modulus (300%)		1500	1770	2290
Sulfur	(2.0)	Ultimate tensile strength	60	2860	2900	2920
Thiofide	(1.0)	Elongation		520	480	390
Thiurad	(1.0)	Torsional hysteresis (log. decr.)		.44	.39	.20
2.		Modulus (300%)		1930	2200	2580
Sulfur	(2.0)	Ultimate tensile strength	60	2450	2700	2580
Tellurac	(3.0)	Elongation		430	370	300
		Torsional hysteresis (log. decr.)		.45	.36	.18
3.		Modulus (300%)		1850	2030	2550
Sulfur	(2.0)	Ultimate tensile strength	60	2560	2580	2670
Ethyl Selenac	(3.0)	Elongation		430	400	330
		Torsional hysteresis (log. decr.)		.47	.38	.18
4.		Modulus (300%)		2400	2110	....
Sulfur	(2.0)	Ultimate tensile strength	30	2400	2360	2220
GMF	(6.0)	Elongation		300	350	290
Red lead	(10.0)	Torsional hysteresis (log. decr.)		.32	.28	.20
5.		Modulus (300%)		1710	1410	1570
GMF	(6.0)	Ultimate tensile strength	30	2270	2210	2100
Red lead	(10.0)	Elongation		420	450	410
		Torsional hysteresis (log. decr.)		.34	.31	.25
6.		Modulus (300%)		1730	1820	1880
Dibenzo GMF	(6.0)	Ultimate tensile strength	30	2330	2285	2220
Red lead	(10.0)	Elongation		420	400	360
Sulfur	(2.0)	Torsional hysteresis (log. decr.)		.43	.39	.26
7.		Modulus (300%)		1820	1930	....
Dibenzo GMF	(6.0)	Ultimate tensile strength	30	1930	1930	1820
Red lead	(10.0)	Elongation		320	300	290
		Torsional hysteresis (log. decr.)		.43	.41	.28
8.		Modulus (300%)			1550	2270
Sulfur	(2.0)	Ultimate tensile strength	45		2740	2720
Thiotax	(2.0)	Elongation			490	400
Thiurad	(1.0)	Torsional hysteresis (log. decr.)			.38	.17

Electrical Resistivity and Low-Temperature Properties after Modification

Significant changes which are obtained in the low-temperature properties and electrical resistivity of butyl rubber as a result of chemical modification by Elastopar are shown in Table 11. The T_{2000}, that temperature where torsional modulus is 2000 psi., is lowered by 24° F. The striking increase in electrical resistivity, from 10^6 to 10^{14} ohm-cm., signifies much improved dispersion of carbon black in the butyl rubber polymer.

Table 11. Low-Temperature and Electrical Resistivity—Norm[a] vs. Heat-Treated Butyl Rubber Stocks

	Normal Control	Heat-Treated Control	Heat-Treated Elastopar Modified
T_{2000}, °F., Clash-Berg	+7.7	+9.5	−16.6
Electrical resistivity, ohm-cm.	2.7×10^5	3.9×10^6	4.9×10^{14}

Silica- and Clay-Reinforced Stock Modification

Gessler and Rehner[5] have shown that improvements in modulus and resilience of silica-reinforced butyl rubber vulcanizates are realized through heating a butyl/silica system in the presence of Dibenzo GMF. Figure 4 shows the effects of using Elastopar-modified butyl rubber in silica- and clay-loaded stocks. The formulations and mixing conditions for these stocks are listed in Table 12. The 500% moduli are doubled, and torsional hysteresis values are markedly decreased with the use of modified butyl rubber.

Table 12. Recipes and Mixing Conditions for Clay and Silica Stocks

I. Mix on rubber mill @ 122° F.

	Base A
Enjay Butyl 217	100.0
Elastopar	1.5

II. Heat treatment in air oven, 4 hours/212° F.

III. Compound on rubber mill @ 122° F.

	1	2	3	4
Enjay Butyl 217	100	...	100	...
Base A	...	100	...	100
Hi-Sil* 233	50	50	...	...
Suprex Clay†	...	...	65	65
Stearic acid	2	2	1	1
Glycerol	3	3	...	...
Zinc oxide	5	5	5	5
Ethyl Tellurac	1	1	1	1
Sulfur	2	2	2	2

IV. Cure 45'/307° F.

*Hi-Sil—A registered trade mark of Pittsburgh Plate Glass Co., Pittsburgh, Pa.
†Suprex Clay—A registered trade mark of J. M. Huber Corp., New York.

Elastopar Masterbatches

Since the new modifier is effective at low dosages, its use in the masterbatched form may be desired. In view of the predicted high reactivity of Elastopar with

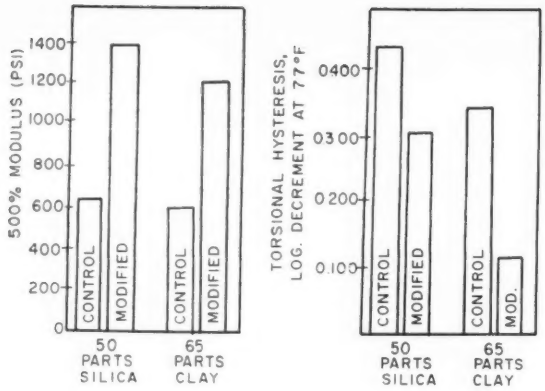

Fig. 4. Effects of chemical modification in silica and clay stocks

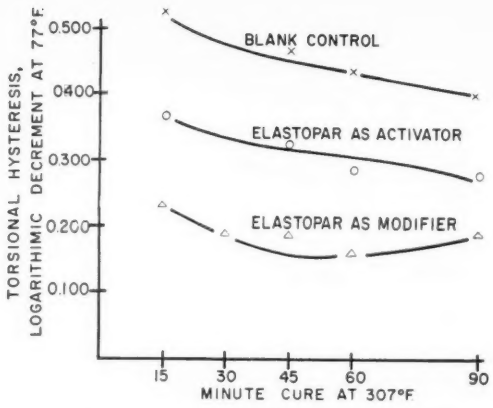

Fig. 5. Function of Elastopar as vulcanization activator *versus* modifier

the butyl rubber molecule, the advisability of using butyl rubber as the matrix in the preparation of masterbatch was thought to be questionable. Polyisobutylene, having no unsaturation, would be expected to be inert to Elastopar; therefore, a commercial grade, Vistanex,[13] was chosen for evaluation. Masterbatches of 37.5% concentration of modifier were prepared in both Enjay Butyl 217 and Vistanex. Temperature of the mill rolls on which the masterbatches were prepared was 122° F. Table 13 shows the results obtained through use of the two masterbatches.

Table 13. Elastopar Masterbatches

I. Preparation of masterbatches on mill at 122° F.			
	A	B	
Enjay Butyl 217	62.5	...	
Vistanex	...	62.5	
Elastopar	37.5	37.5	
II. Heat treatment in Banbury, procedure in Table 1			
	1	2	3
Enjay Butyl 217	100.0	100.0	100.0
Elastopar	1.5	....	....
A	....	4.0	....
B	....	....	4.0
MPC black	35.0	35.0	35.0
HAF black	15.0	15.0	15.0
III. Final compounding			
Zinc oxide	5.0	5.0	5.0
Thiofide	1.0	1.0	1.0
Thiurad	1.0	1.0	1.0
Sulfur	2.0	2.0	2.0
IV. Cure 45'/307° F.			
300 Modulus (psi.)	2000	1580	1880
Ultimate tensile strength (psi.)	2710	2770	2600
Elongation (%)	440	500	430
Torsional hysteresis (log. decr.)	0.182	0.289	0.205

The data show that use of Enjay Butyl 217, which has an unsaturation of approximately 2 mole %, does not give so good a balance of properties as are obtained from the stock prepared with the Vistanex masterbatch. Vistanex is, of course, completely compatible with butyl rubber, and the small quantity added to the recipe should act merely as a softener and extender without adverse effect.

[13]Vistanex—A registered trade mark of Enjay Co., Inc.
[14]United States patent No. 2,457,331 (Dec. 28, 1948), assigned to E. I. du Pont de Nemours & Co., Inc.

Other Evidence for Chemical Modification

One of the most readily recognized of the distinguishing properties of a vulcanizate of Elastopar-modified butyl rubber is a sensation of improved resilience and snap when the cured stock is flexed manually. The leathery quality of the control stock contrasts sharply with the greater ease of deformation and quicker and more nearly complete return upon release of the modified stock.

Three observations have been made which point very strongly to the existence of a chemical reaction of butyl rubber with the modifier. A sample of Elastopar-modified butyl rubber has been shelf-aged eight months and exhibits none of the cold flow which characterizes conventional butyl rubber. A condition of reduced surface tack also has been observed. Ultraviolet spectrophotometric analysis has shown that there are no significant residual quantities of unchanged modifier following the chemical modification step.

Figure 5 summarizes torsional hysteresis comparisons of control and Elastopar-modified stocks *versus* one in which the modifier was incorporated as an activator for the vulcanizing system. The activated stock parallels the work of Trepagnier,[14] in which he showed that N-methyl-N,4-dinitrosoaniline was an effective activator for butyl rubber. The data reveal that a much different effect is obtained when Elastopar functions as a chemical modifier than when it is present as an activator in the final mix. The gum polymer contains no benzene-insoluble material after modification.

Summary and Conclusions

A new approach is presented toward obtaining improved properties in butyl rubber vulcanizates through chemical modification of the butyl rubber polymer by N-methyl-N,4-dinitrosoaniline. Chemical modification by this additive may be carried out in a Banbury mixer at conventional mixing times and temperatures. The use

(Continued on page 428)

Influence of Nitrogen Dioxide on the Aging of Foam Rubber[1]

By H. L. GOEBEL and E. G. BARGMEYER and P. D. BRASS and J. U. MANN
United States Rubber Co., Mishawaka, Ind. *U. S. Rubber, Passaic, N. J*

Unique aging effects occasionally exhibited by foam rubber products after relatively short periods of service have been found due to exposure of such items to the nitrogen oxides in the combustion fumes of fuel gases. These oxides of nitrogen are also responsible for the discoloration of antioxidants, or of rubber by antioxidants.

Different types of apparatus for duplicating the conditions of deterioration of foam rubber are described. Test results are presented to show the effects of a selected group of antioxidants on this type of aging.

Protective materials are required that will not only eliminate or reduce discoloration, but will minimize or eliminate the surface deterioration of foam rubber products exposed to fuel-gas combustion fumes. This situation presents a challenge to the manufacturers of antioxidants.

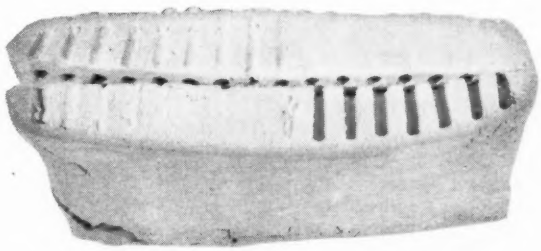

Fig. 1. Foam rubber furniture cushion returned from service. Discolored and harsh and doughy surface for the depth of 1/2 inch was evidenced

DURING the past three or four years the rubber industry has become increasingly aware of a new problem in connection with the aging of rubber products. Producers of latex foam rubber have been experiencing the occasional return of goods exhibiting a peculiar vivid surface coloration varying from yellow through orange to reddish-brown.

Figure 1 shows a furniture seating cushion of foam rubber returned some time ago from the southwestern United States where the penetration of the discoloration had progressed into the surface of the foam rubber to the depth of approximately ½ inch. Inspection of the discolored portion of this cushion indicated that the physical characteristics had changed from soft and resilient to what might best be described as harsh or doughy. Examination of other cushions evidencing this discoloration indicated also that the affected areas might range in properties from doughy to a crusty condition.

Attempts to explain this discoloration and deterioration of surface properties of latex foam sponge rubber as due to the influence of light, heat, oxygen, or the presence of pro-oxidant metal impurities in the material were not successful. Use of the usual accelerated aging tests did not result in duplication of the effects shown by foam sponge products returned from the field.

Continued study of this discoloration and deterioration problem subsequently led to the conclusion that, as far as could be determined, cushions exhibiting these effects were being returned from scattered sections of the country where homes were heated predominantly with gas. Direct contact with consumers in these several locations gave further indication that all the cushions returned had been in service in homes in which unvented gas heaters were in operation. These findings led to an investigation of the effect of gas combustion fumes on rubber cushioning materials.

The literature reveals that among the combustion products of fuel gases are to be found certain oxides of nitrogen.[2-7] It is also disclosed that such oxides of nitrogen react with rubber as well as with olefins in general.[8] Evidence of this fact is found from the analyses for nitrogen content of certain foam rubber products after use in different areas of the country and/or under different service conditions, as shown in Table 1.

Table 1. Nitrogen Analyses of Foam Rubber Products

Product	% Nitrogen	
	Exposed (Deteriorated) Section	Inside (Unchanged) Section
Mattress, Los Angeles, Calif.	0.57	0.38
New York, N. Y.	0.45	0.41
Pillow	0.51	0.40

[1]Presented before the Division of Rubber Chemistry, ACS, Cleveland, O., May 17, 1956.
[2]Hall, *Gas*, 28, 54-58 (1952).
[3]Bacon, *Petroleum Engineer*, 11, 51 (1940).
[4]Hanson and Egerton, *Proc. Roy. Soc.*, A163, 90 (1937).
[5]Elkenbard *et al.*, *J. Phy. Chem. (USSR)*, 13, 464 (1939).
[6]Schlapfer, Schweiz, *ver. Gas-u Wasserfach, Monats-Bull.*, 17, 147 (1937).
[7]Salvin, Paist, Myles, *Dyestuff Reporter*, 41, 297, (1952).
[8]Bloomfield and Jeffrey, *J. Chem. Soc.*, 120 (1944).

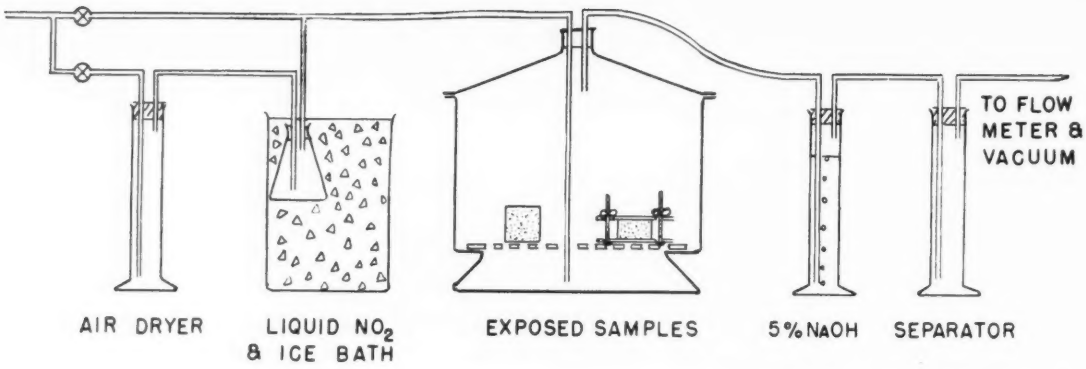

Fig. 2. Laboratory apparatus for the aging of foam rubber with controlled amounts of nitrogen dioxide in air

The data show the differences in nitrogen contents of specimens taken from the inside and outside portions of mattress and pillow samples. The mattress which had been in service in a New York steamheated apartment showed only a slight yellowing and was otherwise not affected. The mattress which had been in use in a Los Angeles home, where unvented gas heaters were utilized, exhibited a pronounced yellow discoloration with doughy and crusty areas. The pillow, also from a home in which unvented gas heaters were employed, showed similar yellow discoloration and some surface deterioration.

The fact that the appearance and the feel of foam rubber exposed to an atmosphere containing gas combustion fumes are so typical and yet so unlike the effects produced by other factors well known for their aging and deteriorating action on rubber products served as an incentive for further investigation. When the magnitude of the study of this problem from a large number of angles and for a wide variety of compounds was considered, however, it became evident that an experimental program of limited scope, but capable of yielding practical results, was the most desirable for reasons of expediency. Such a program was designed with the following limitations, therefore:

1. The study would be confined mainly to natural rubber and styrene-butadiene rubber (SBR) compounds since these elastomers are the ones used predominantly in the foam rubber industry. Where it seemed desirable to consider other types of foam (i.e., polyurethane, acrylonitrile, neoprene, and vinyl), the investigation would be cursory and aimed at furnishing data principally for purposes of rough comparison.

2. The compounds studied would be formulated within the limits of practical application.

3. Testing equipment and methods used should attempt to duplicate in the laboratory effects exhibited by cushions returned from the field.

It is not intended that the work reported in this paper will be considered complete, but it is hoped that the information reported will be helpful to the foam rubber industry as a whole in its attempts to improve the quality of its products. Consequently the primary purpose of this paper is to discuss the work carried out in the Koylon[9] foam laboratories of United States Rubber Co. Herein are described the design and the operation of equipment for studying aging of various foam rubber compounds when exposed to an atmosphere containing gas combustion fumes and oxides of nitrogen.

Aging Effects of Nitrogen Oxides

NO_2 Exposure Tests

Studies[10] made at the general research and development laboratories of U. S. Rubber include determinations of the influence of both nitrogen dioxide and sulfur dioxide on foam rubber. The results indicated that a large variety of foam rubber compounds suffers no immediate ill effects from exposure to sulfur dioxide, but heat aging properties (200° F. in air) are seriously affected when foam rubber containing pro-oxidant metal (iron, as iron oleate) is exposed to sulfur dioxide, prior to aging.

The effects of nitric oxide or nitrogen dioxide in foam rubber were found to be much more pronounced. Foam rubbers exposed to high concentrations of nitrogen dioxide (brown atmosphere) charred in less than one minute.

In order to study the effects of controlled concentrations of nitrogen dioxide an apparatus, shown in Figure 2, was assembled. The system herein illustrated is made of glass as far as possible. The air entering the flask was dried by passing it through sulfuric acid. The 250-milliliter flask containing the nitrogen dioxide has a glass stopper into which the glass tubes are fused. The short length of capillary tubing is inserted into the line to minimize diffusion. A large desiccator holds the samples during treatment. Between the desiccator and the flow meter is placed a gas washing bottle containing sodium hydroxide solution to absorb most of the unreacted nitrogen dioxide.

In the operation of this equipment, a large volume of air is pulled through the apparatus (about seven liters per minute), and a small amount of air (less than one cubic centimeter per minute) containing nitrogen dioxide is bled into this main stream. The flask is immersed into an ice bath to maintain it as 0° C., at which temperature the vapor in the flask is one-third nitrogen dioxide.

[9]Registered trade mark.
[10]Brass and Mann, unpublished reports, *U. S. Rubber Co.* (1953).

Harold L. Goebel

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The Authors

Harold L. Goebel, director of product and process development, latex foam division, United States Rubber Co., Mishawaka, Ind., received his B.S. in chemcial engineering in 1935, his M.S. in physical chemistry in 1936, and his Ph.D. also in physical chemistry in 1938, all from the University of Notre Dame.

He has been with U. S. Rubber at Mishawaka since 1938. In 1940 he was placed in charge of technical control and development for the division; from 1942-1944 he was assigned to the development of fuel-cell materials; he has held his present position since 1944.

Dr. Goebel is a member of the American Chemical Society and has served as chairman of the St. Joseph Valley local section. With U. S. Rubber he has conducted classes in foremanship and technical supervisor training.

Ernest G. H. Bargmeyer, executive research chemist, foam rubber division, at Mishawaka, was graduated from the University of Washington with a B.S. in chemistry in 1930.

Mr. Bargmeyer has been with U. S. Rubber at Mishawaka since 1930 in various development capacities since that time. The main emphasis of his work has been with latex products.

He is a member of the ACS and its Division of Rubber Chemistry and has been chairman and treasurer of the ACS St. Joseph Valley Section.

Philip D. Brass, group leader, latex and plastics research department, General Research and Development Laboratories, U. S. Rubber, Passaic, N. J., received his B.S. in chemistry from Yale University in 1928 and his Ph.D. from California Institute of Technology in 1932.

Dr. Brass has been with U. S. Rubber since 1933, first until 1937 at the General Laboratories, then from 1937 until 1947 at the Providence, R. I., plant, and from 1947, again at the General Laboratories.

He is a member of the American Chemical Society and has been on the Editorial Advisory Board of RUBBER WORLD for several years. With W. A. Gibbons, Dr. Brass contributed a chapter to the "Chemistry and Technology of Rubber," by Davis and Blake. A chapter in "Machinery and Equipment for Rubber and Plastics" and in the "Vanderbilt Latex Handbook," were also written by Dr. Brass.

James U. Mann received his B.S. in chemistry from Lafayette College in 1934. He has been with U. S. Rubber at the General Laboratories as a chemist since graduation.

Mr. Mann is a member of the Rubber Division of the American Chemical Society and has several patents in the field of latex technology.

By adjusting the valves at the inlet end of the apparatus it is possible to control the volume of air which bubbles through the nitrogen dioxide. The rate is slow enough to permit the assumption that equilibrium conditions are maintained in the flask.

Flow of the air-nitrogen dioxide mixture is measured with a flow meter. Flow of air through the NO_2 flask is measured occasionally by connecting a one-milliliter graduated pipette to the end of the air intake tube and timing the flow of a drop of water through it.

In using this apparatus, as little as ½-hour exposure of the samples to an atmosphere containing about 20 ppm of nitrogen dioxide caused the development of colors characteristic of the antioxidants in the compounds used. After 24 hours' exposure the samples were tacky, weaker, and more deeply colored. Subsequent work indicated that by operating the equipment at lower concentrations of nitrogen dioxide (ca 10 ppm) the coloration or discoloration and surface condition of the exposed samples could be made to match the effects observed on goods returned from service.

In general, it was observed that the phenolic antioxidants studied gave more protection to the foam rubber than did the amine types. Moreover, foam rubbers

containing such phenolics were not so strongly colored.

The presence of pro-oxidant metal (iron added as iron oleate) speeded the deterioration of foam rubber when exposed to nitrogen dioxide. These effects are tabulated in Table 2.

Table 2. Effect of Pro-Oxidant Metal on NO_2 Aging of Foam Rubber

		After 24 Hrs. in 20 Ppm NO_2		
Antioxidant	Iron	Color	Tackiness	Hand Tensile
None	none	cream	slight	strong
None	0.2	lt. tan	some	weak
AgeRite White*	none	brown	slight	weak
	0.2	brown	some	very weak
Wingstay S†	none	tan	slight	strong
	0.2	tan	much	weak

*R. T. Vanderbilt Co., New York.
†Goodyear Tire & Rubber Co., chemical division, Akron, O.

Although tests can be carried out in a relatively short period of time, the amount of manual control necessary for obtaining significant results detracts from the practicability of this equipment for running routine tests on large numbers of samples.

Figure 3 shows some typical results obtained from the exposure of foam rubber samples and white latex films to nitrogen dioxide at 10 ppm, compared with samples exposed for two hours in the Fade-Ometer.[11] Conditions of exposure in the Fade-Ometer were controlled by the use of the 22-hour National Bureau of Standards fading paper.

Further study employing this equipment indicated that the state of cure of the foam rubber influences the rate of deterioration in nitrogen dioxide. In tests with a series of samples containing no added antioxidant, the sample with 2.5 parts of total sulfur had a rate of deterioration less than the rates of compounds containing 1.5 or 1.0 parts of sulfur. Removal of the dithiocarbamate accelerator from the compound increased the rate of deterioration.

Nitric Acid Fume Tests

In an attempt to find a shorter method for determining the influences of oxides of nitrogen on compounds containing varying amounts of different antioxidants a rather simple setup was devised and evaluated in the company's foam rubber laboratories. Foam rubber samples of various compositions were cemented to the underside of mason-jar lids which were then screwed on to quart jars containing approximately 100 milliliters of 25% nitric acid. The samples were exposed for six days, after which their condition was examined and weight gains were determined.

An analysis of the results obtained with this method led to the conclusion that the treatment is too drastic. Samples showed immediate resinification at the surface apparently counterbalanced by some softening underneath. The test might work better if carried out at a lower concentration of nitric acid in the desiccator and with the temperature of the atmosphere in the desiccator thermostatically controlled. Weight changes were found to be dependent to some extent on humidity.

Field-Service Tests

In order to corroborate laboratory findings as regards the effect of nitrogen dioxide on foam rubber of various compositions, it was decided to place service-test pillows in a California home known to be heated with unvented gas burners. These test pillows were hand fabricated from a number of sections representing various foam rubber compositions.

After two years the pillows were returned and examined. The results substantiated the observations made in connection with Figure 3: namely, that compounds containing the amine-type antioxidants show a more vivid coloration than did those containing the phenolic types.

Effects of Gas Combustion Fumes

In order to duplicate the conditions to which service-test cushions would be subjected when placed in homes where unvented gas burners are used for heating, a gas flue was constructed, as illustrated in Figures 4 and 5.

Description of Equipment

The flue consists of a sheet-metal duct 13 inches in diameter and 5 feet 4 inches high, erected on legs one foot long. A gas burner at the base burns natural gas with a slightly luminous flame which impinges on a perforated stainless steel plate. The combustion products flow upward through the plate and a stainless-steel screen 12 inches above the plate. Just below the screen compressed air is bled into the system so as to dilute and cool the combustion gas.

The mixture of air and gas then passes through three sets of helical cooling coils through which tap water flows. The amount of gas to the burners is adjusted so that the temperature of the combustion gas around the samples is 100° F. The amount of air used must be such as to result in no noticeable condensation of water on the cooling coils.

Other stainless-steel screens near the top of the flue are used to hold the samples being tested.

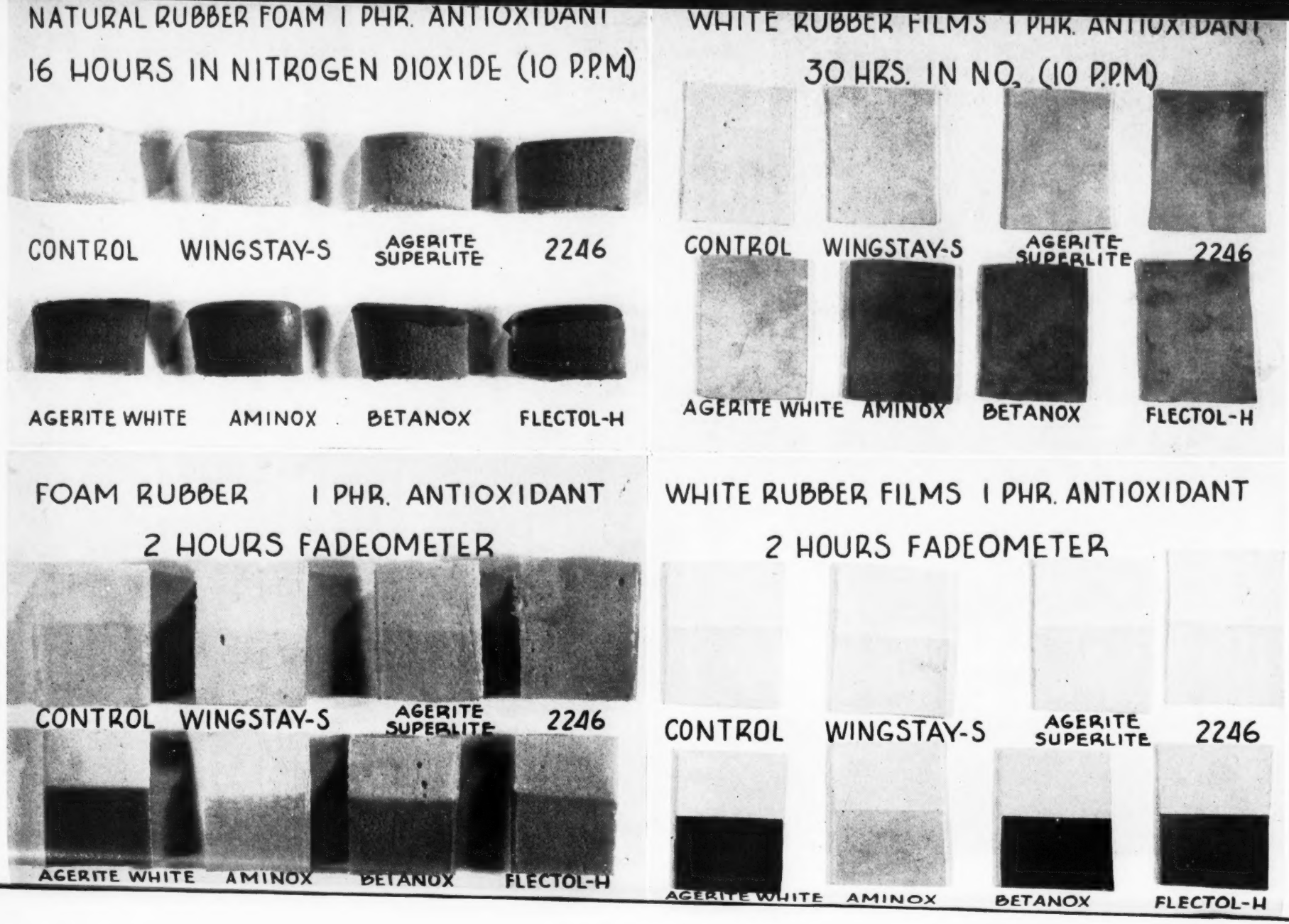
Data for Operation

The analysis of gas used in test runs is in Table 3.

[11] "An apparatus for accelerated light aging and light fastness testing of samples of vulcanized rubber and of plastics under the action of artificial light from an electric arc between carbons treated to produce a spectrum closely resembling that of sunlight . . . " "Glossary of Terms Relating to Rubber and Rubber-Like Materials," ASTM Special Technical Publication No. 184, p. 119. American Society for Testing Materials, Philadelphia, Pa. The Fade-Ometer is made by Atlas Electric Devices Co., Chicago, Ill.

Fig. 3. *(facing page)* Typical results from exposure of latex foam rubber and white latex rubber films containing various antioxidants to nitrogen dioxide (10 ppm). Results of exposure of same compounds to Fade-Ometer included for comparison. *Upper left:* latex foam rubber after exposure to nitrogen dioxide. *Lower left:* latex foam rubber after Fade-Ometer exposure. *Upper right:* white latex rubber after exposure to nitrogen dioxide. *Lower right:* white latex rubber after Fade-Ometer exposure

AGERITE WHITE AMINOX BETANOX FLECTOL-H AGERITE WHITE AMINOX BETANOX FLECTOL-H


NATURAL RUBBER FOAM 1 PHR. ANTIOXIDANT
16 HOURS IN NITROGEN DIOXIDE (10 P.P.M)
CONTROL
WINGSTAY-S
AGERITE SUPERLITE
2246
AGERITE WHITE
AMINOX
BETANOX
FLECTOL-H
WHITE RUBBER FILMS 1 PHR. ANTIOXIDANT
30 HRS. IN NO2 (10 P.P.M)
CONTROL
WINGSTAY-S
AGERITE SUPERLITE
2246
AGERITE WHITE
AMINOX
BETANOX
FLECTOL-H
FOAM RUBBER 1 PHR. ANTIOXIDANT
2 HOURS FADEOMETER
CONTROL
WINGSTAY-S
AGERITE SUPERLITE
2246
AGERITE WHITE
AMINOX
BETANOX
FLECTOL-H
WHITE RUBBER FILMS 1 PHR. ANTIOXIDANT
2 HOURS FADEOMETER
CONTROL
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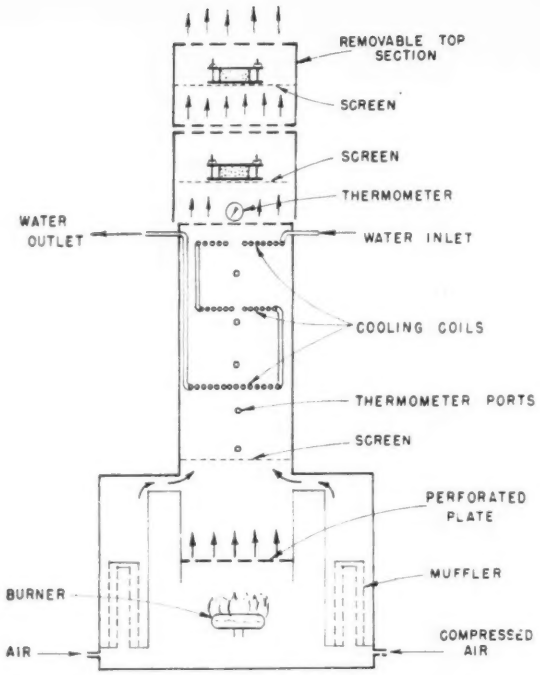


Fig. 4. Schematic drawing of specially constructed gas flue combustion apparatus for the aging of foam rubber samples under conditions simulating service in the field. Samples were placed on stainless-steel screens at top of apparatus

Table 3. Analysis of Burner Feed Gas (Natural Gas)

BTU	=	1030/ft³
Specific gravity	=	0.675 (air 1.0)
Methane	=	79.6%
Ethane	=	5.4%
Propane	=	3.7%
Butane	=	1.3%
Pentane	=	0.1%
Hydrogen	=	9.9%

During the tests the following controlled conditions were maintained in the flue operation, as shown in Table 4:

Table 4. Burner Control Data

Gas flow (to burner)	3.27 liters/min.
Air flow (compressed air)	1.10 liters/min.
Gas temperature (surrounding sample)	100° F. ±3° F.
Relative humidity at top of flue	30%
Rate of gas flow (combustion products) at top of flue	29.2 ft/min.
Nitrogen dioxide content of combustion products	1 ppm

Test Procedure

In considering the data which might be obtained from a gas flue aging test, it was decided that not only was the color change of the sample important but also changes in compression and permanent set that might occur.

PREPARATION OF SAMPLES. Foam plugs 1.5 inches in diameter and two inches high were die cut from the stock to be tested. Both skin surfaces were then buffed to give uniform permeability. The height was then measured.

Next the surfaces were powdered with talc; then the sample was clamped in a suitable holder to a compressed height of 50% of its original, as shown in Figure 6.

The holder consists of a three- by three-inch aluminum plate containing a two-inch center hole. Spot welded to each plate is a 12-mesh stainless-steel screen. Adjustment of the sample height was made by means of wing nuts on bolts passing through the corners of the plates.

RUNNING THE TEST. The clamped sample was placed on a stainless-steel screen located near the top of the flue. The temperature of the combustion products-air mixture was maintained at 100 ±3° F., insofar as possible.

After 48 hours' exposure the sample was taken from the flue and the clamp removed. After the sample has been allowed to recover for one hour, the height was measured and the compression set calculated according to ASTM D395-53T Method B.[12]

The sample was then replaced in the clamp, and exposure to flue gas repeated. The test was considered completed when the permanent set has reached 60%, which usually required 48 to 72 hours.

Progress of deterioration was followed also by making visual observations of the changes occurring. Such characteristics as coloration, softening (stickiness) or hardening (resinification) were recorded.

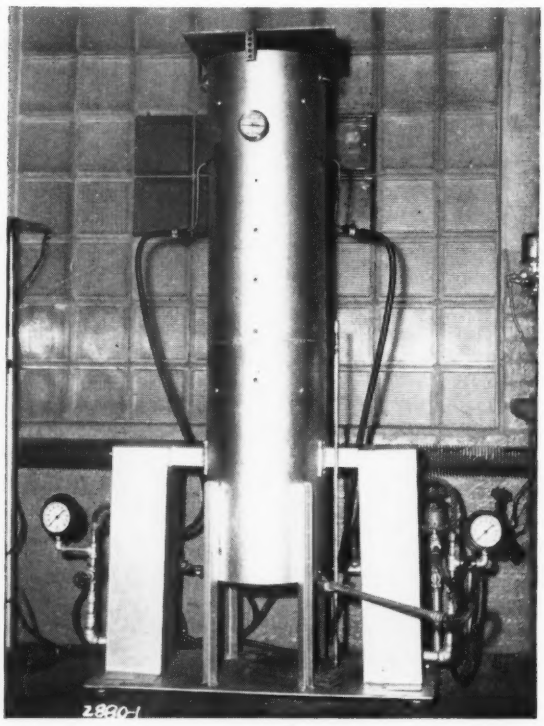


Fig. 5. Photograph of gas flue combustion apparatus for foam rubber aging

[12]American Society for Testing Materials.

Results and Discussion

Effect of Density

As indicated in Table 5, the effect of foam rubber density appears to be within the limits of experimental error.

Table 5. Effect of Density

Density, Lbs/Ft.^{3}	Hours to 60% Set
0.0025	124
0.0029	158
0.0040	139

Effect of Antioxidants

The base recipe used in the compounds studied is shown in Table 6.

Table 6. Foam Rubber Base Compound

Component	Parts Dry Weight
Creamed latex	100
Potassium oleate	2.0
Hydroxide	0.3
Zinc diethyldithiocarbamate	1.0
Mercaptobenzothiazole	1.0
Sulfur	2.0
Zinc oxide	5.0
Trimene Base*	1.0
Antioxidant	as shown

*Naugatuck Chemical Division, U. S. Rubber, Naugatuck, Conn.

Natural rubber latex was employed in this study since the foam rubber industry is utilizing predominantly compounds in which natural rubber is the major constituent.

In Table 7 are presented some data on the influence which various antioxidants exert on foam rubber samples exposed to gas combustion fumes.

In this study the number of hours of exposure to effect a 60% set was arbitrarily chosen as a basis for comparison. An examination of the data shows little correlation between "weight gain" and "hours to 60% set." This situation may be due to peculiar surface area effects, since the attack of the fumes was at the surface of the rubber.

As far as the protective characteristics of the antioxidants are concerned, the study presents no clear-cut picture. While some of the phenolic types (2246 and Wingstay S) appear to improve the resistance of foam rubber to the combustion fumes, others (AgeRite Superlite, Styphen I, and Nonox WSL) show no particular advantage. Some of the amine-type antioxidants generally recognized as giving excellent resistance to heat aging appear to accelerate deterioration of foam rubber in the gas fumes.

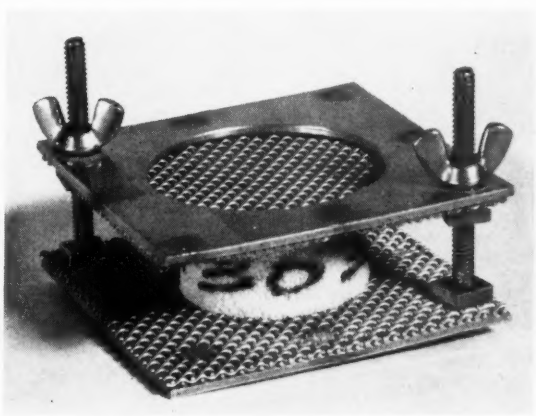


Fig. 6. Jig for compression set testing of foam rubber samples

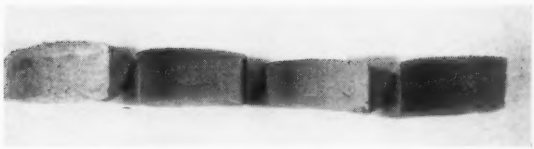


Fig. 7. Effect of gas combustion fumes on *(left to right)* natural, styrene-butadiene, nitrile, and polyurethane foam rubbers

Table 7. Gas Flue Aging—Effect of Antioxidants—Natural Rubber Compounds

Antioxidant	Hours to 60% Set	Weight Gain Mg/100 Hrs.
None	186	84
1.0 Wingstay S	197	80
2.0 Wingstay S	223	73
1.0 Aminox*	123	86
1.0 Betanox*	153	105
1.0 Flectol H†	112	98
1.0 AgeRite Superlite‡	161	85
1.0 Antioxidant 2246§	274	65
1.0 Sulfasan R†	157	85
1.0 Santovar A†	164	71
1.0 Nonox WSL¶	161	75
1.0 Styphen I‖	133	87
1.0 AgeRite White‡	292	56

*Naugatuck Chemical.
†Monsanto Chemical Co., rubber chemicals department, Akron, O.
‡R. T. Vanderbilt Co.
§American Cyanamid Co., rubber chemicals department, Bound Brook, N. J.
¶Imperial Chemical Industries, Ltd., London, England.
‖Dow Chemical Co., Midland, Mich.

Although it was mentioned and shown previously that foam rubbers containing the amine antioxidants exhibit a more pronounced color change than do those containing the phenolic antioxidants, there appears to be no correlation between the degree of coloration and the extent of surface degradation.

In general, indications are that antioxidants of both types discolor and/or stain.

Table 8. Staining of Bleached Cotton Sheeting by Foam Rubber—Gas Flue Exposure

Parts Antioxidant	Amount of Stain (120 Hrs.)
None	none
1.0 AgeRite Superlite	none
1.0 AgeRite White	none
1.0 Betanox	none
1.0 Flectol H	very slight
1.0 Antioxidant 2246	slight pinkish
1.0 Wingstay S	yellow
2.0 Wingstay S	moderate yellow
1.0 Aminox	yellow

In Table 8 a comparison of the antioxidants as regards staining tendencies is shown. The information was obtained on foam rubber samples wrapped in unbleached

cotton sheeting and exposed to the gas fumes in the test flue for 120 hours.

Indications are that in those cases where the stains produced by certain antioxidants are fugitive when exposed to strong light, a more practical index of staining tendencies might be derived from exposure of samples to gas combustion fumes.

Discoloration of Other Types of Foam Rubber

In order to determine what influence the exposure to gas combustion fumes might have on some of the other types of foam rubber, a series of samples was prepared and subjected to test. Although this work was in progress at the time this paper was written, some information available at that time is shown in Figure 7.

It appears that the color changes induced in polyurethane foams, when exposed to gas combustion fumes, resemble such changes suffered by the natural, styrene-butadiene, and nitrile foam rubbers.

Summary and Conclusions

The unique aging effects occasionally exhibited by latex foam rubber products after a relatively short period of service, are attributed to exposure of such items to the combustion fumes of fuel gases. The fact that these fumes are known to contain oxides of nitrogen suggests the possibility of reproducing these aging effects in the laboratory. Three methods and types of equipment for accomplishing this aging have been described. These involve exposure of samples to:

1. Controlled concentrations of nitrogen dioxide. This method was found to be satisfactory, but difficult to manipulate.
2. Nitric acid fumes. The treatment involved in this method was found to be too drastic and incapable of yielding reproducible results.
3. Combustion products from burning fuel gas. This method was found to be simple to operate and practical for the routine testing of large numbers of samples.

Studies involving various compounds exposed to nitrogen dioxide and burning gas fumes revealed that:

1. Antioxidants contribute to the pronounced coloration or discoloration, but may or may not inhibit surface degradation of the foam rubber.
2. Some antioxidants may induce foam rubber compounds to stain. Exposure of samples to nitrogen dioxide or combustion fumes of gas may aid in bringing out staining qualities otherwise difficult to detect.
3. Polyurethane foam discolors and suffers degradation to an extent dependent upon its composition. In some instances the deterioration resembles that suffered by some polyester types when exposed to humid atmosphere.
4. Styrene-butadiene and nitrile foam rubbers discolor to an extent dependent upon the antioxidant used in their formulation. In all cases the samples become more tender following gas fume aging.

It might be said that since the evidence indicates that these unique aging effects on foam rubber products are produced under atmospheric conditions not generally considered conducive to maintaining respiratory organs at their physical best, the frequency of returned goods deteriorated and discolored from exposure to nitrogen dioxide in the atmosphere should remain at a low level. Nevertheless, because of the unusual nature of the aging effects obtained on exposure of foam rubber to nitrogen dioxide in fuel gas combustion products, it is conceivable that the effects of nitrogen dioxide on the aging of rubber products in general should be examined.

Analysis of the data indicates that the adverse effects of nitrogen dioxide on the aging of foam rubber can be minimized by compound modifications, if the presently available antioxidants can be improved to provide some additional measure of protection.

The situation presents a challenge to the manufacturers of antioxidants. Not only are antioxidants required that will eliminate or reduce the discoloration, but the protective materials should be able to minimize or eliminate the surface deterioration of foam rubber products.

New Impulse Generator

An impulse generator of advanced design, rated 1,400,000 volts with an energy of 16 kilowatt-seconds, went into service recently in the high-voltage laboratory of Simplex Wire & Cable Co., Cambridge, Mass. The installation is expected to play a dominant role in an expanding research and development program.

Said to be the first of its kind in the United States, the generator was manufactured by North American Philips Co., Inc., Mount Vernon, N. Y. Small dimensions, low self-inductance, low stray capacitance, and high stored energy are reported to be features of the new impulse generator. Full energy is available at ½ and ¼ nominal voltage, and the design allows for the possibility of impulse current testing.

Simplex studies will cover variations in mechanical construction of cable and insulation factors on materials of varying thickness, as well as other problems.

Butyl Rubber Vulcanizates

(Continued from page 420)

of modified polymer is advantageous in both black- and non-black-loaded stocks and is advantageous also with respect to variation over the spectrum of vulcanizing systems which are normally used with butyl rubber. A successful plant demonstration of chemical modification has been carried out.

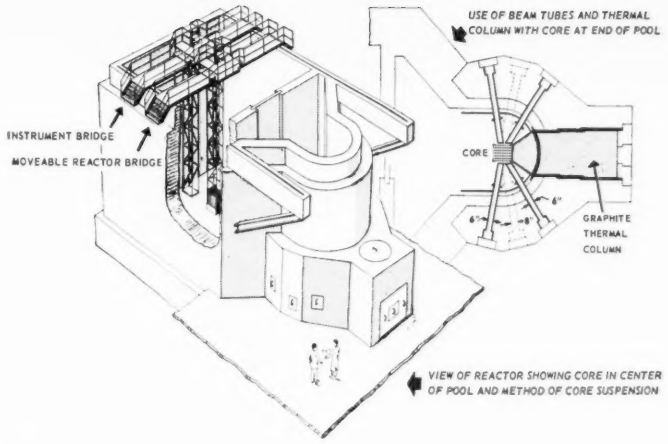
Acknowledgments

The Armstrong Rubber Co., West Haven, Conn., for the use of Banbury mixing equipment.

The Esso Research & Engineering Co. for factory processing and test data.

R. W. Wise, of Monsanto Chemical Co., for analytical data.

Battelle Nuclear Reactor


USE OF BEAM TUBES AND THERMAL COLUMN WITH CORE AT END OF POOL
INSTRUMENT BRIDGE
MOVEABLE REACTOR BRIDGE
CORE
GRAPHITE THERMAL COLUMN
VIEW OF REACTOR SHOWING CORE IN CENTER OF POOL AND METHOD OF CORE SUSPENSION

Two schematic views of Battelle's one-million-watt nuclear reactor show method of suspension of core in the center of a pool of water and position of graphite thermal column

A ONE-MILLION-WATT research nuclear reactor was put into operation in early November at Battelle Memorial Institute, Columbus, O., bringing into existence what is believed to be the nation's first privately owned nuclear research center.

The reactor is the third major new unit added to the Battelle nuclear research center in the past 13 months. The other two units were radiation laboratories and a laboratory for reactor development. Battelle also has ore treatment and chemical engineering laboratories, a reactor materials laboratory, and radiochemical facilities.

According to Dr. H. R. Nelson, who directed development of the center, the entire facility was built in anticipation of the large expansion of nuclear research as a result of the Atomic Energy Act of 1954, which permits private industry to enter upon commercial development of the atom. The center is making available to industry complete facilities for peacetime nuclear energy studies.

The new reactor is essentially a nuclear apparatus for producing gamma rays and neutrons to be used in research to further chemical, metallurgical, electronic, and other technologies. The improvement and development of many chemical, rubber, plastic, ceramic, glass, and metallic products and processes are to be attempted, as well as research on the chemistry of petroleum, sterilization of pharmaceutical products, and preservation of agricultural goods.

The reactor, which cost the Institute $770,000 to build, is the largest of the pool-type yet to be put into service in this country. Located 15 miles west of Battelle's Columbus laboratories, it was designed, is entirely owned, and will be operated by the Institute. The atomics division of the American Machine & Foundry Co. did the construction.

With a rated power of one megawatt, the reactor uses solid uranium-235 fuel. The core, composed of fuel elements and boron control rods, is suspended 22 feet below the surface in a large pool of highly purified water. The water serves as the coolant and as a shield to protect personnel from the radiations. It is expected that these reactors will be operated on a schedule of 24 hours a day, six days in the week.

Two eight-inch and four six-inch-diameter beam tubes extending from the outside vertical walls of the pool through to the face of the core are among the locations where specimens or experiments may be placed to utilize neutron or gamma radiation. A second major location for irradiation is the graphite column that provides two four-foot openings with a thermal neutron flux of 5×10^8 n/cm^2-sec. One of the special features of the Battelle reactor is that access to the thermal column is possible through a horizontal as well as a vertical face.

For fast irradiation of relatively small specimens, the reactor is equipped with a special "weasel tube." This will operate hydraulically to carry two-inch-diameter specimens to and from the core face with a minimum exposure time of about two seconds. Finally, for large experiments, the core may be moved to the center of the 20- by 20- by 28-foot pool area where bulky apparatus may be brought close to its face.

The reactor fuel elements are composed of a uranium-aluminum alloy clad with 2S aluminum. The uranium in the alloy is enriched to 90% uranium-235. There are ten fuel plates in each element and a total of 35 elements containing in all 5.2 kilograms of uranium-235. The 28 standard fuel elements contain 162 grams of uranium-235 each; while the two partial elements, used for fine adjustments in fuel loading, contain 81 grams each.

The five special elements in which the control rods operate contain about 100 grams each. Depending on core geometry, which is flexible, approximately 2.6 to 316 kilograms of uranium-235 are used to achieve criticality—nuclear fission. At a power level of one mega-watt, roughly one gram of U-235 is burned up each day.

Experimental conditions can be arranged to include static irradiations of solids and liquids at room temperature and pressure, irradiation of solid specimens at high temperatures and in a specified medium, and irradiation of fluids in a dynamic system allowing for such conditions as heating and circulation. The reactor is housed in a three-story building, 72 feet wide by 100 feet long.

Making Bigger Silicone Rubber Rolls;

SILICONE rubber-covered rolls as big as 85 inches long and 12 inches in diameter are being made by Rodic Chemical & Rubber Corp., New Brunswick, N. J., in a one-cure, non-toxic, thick section application technique. The rolls are said to be the largest ever fabricated from silicone rubber and are used in the textile, paper, plastics, printing, and other industries.

Rodic is using Union Carbide & Carbon's K-1025 silicone rubber compound and X-1960 catalyst to vulcanize the hand-built rolls. Other manufacturers have achieved equal success in making large silicone rubber rolls with the two materials, UCC says.

K-1025 is a 50 durometer hardness member of UCC's new series of silicone compounds which is said to meet or exceed AMS, ASTM, and MIL-R-5847B specifications. Also available in this series are 60, 70, and 80 durometer hardness compounds.

X-1960 curing compound is said to lock in a catalyst previously too volatile to be used conveniently, providing effectiveness and ease of handling. Stocks catalyzed with X-1960 can be held for as long as two weeks without loss of catalyst, which is equally effective for curing thick sections and carbon black-filled compounds, UCC says.

Summing up the advantages of silicone rubber rolls over those of natural rubber, although the latter costs less, UCC lists the following: non-sticking qualities, ability to remain flexible at very high and very low temperatures, low compression set (15%) without toxic additives, and resistance to ozone and corrosive atmosphere.

The new rolls do not have the soft outer rind generally obtained with steam-cured compounds catalyzed with the previously used benzoyl peroxide-type catalysts. Silicone rubber rolls with hardnesses ranging between 30 and 75 durometer hardness have been made.

The one-step autoclave cure eliminates the four to 14-day programmed postcures formerly needed. In the rare cases where a postcure is needed, UCC adds, 24 hours at 480° F., after a drying step, is usually sufficient.

Fig. 1. Rodic plant technician primes surface of freshly cleaned six by 52-inch steel core as the first of many 1/8-inch calendered sheets of Union Carbide K-1025 silicone rubber compound awaits application on the paper-covered table behind him

Fig. 2. A second silicone rubber sheet is about to be stripped from its paper backing, applied to the first, and smoothed free of air bubbles. The overlap will be cut down during the final grinding process

Fig. 3. Straining for tautness, an operator guides a strip of wet cotton fabric around surface of completely built-up roll rotating on driven axle. Fabric will dry, compressing the silicone rubber

One-Step Cure for UCC Compound

The rolls are being constructed with black iron, steel, bronze, or aluminum cores. Earlier types of silicone rubber required a laborious step-by-step postcure to prevent blowing and delaminating, according to Union Carbide.

In addition to K-1025, UCC's X-1516 silicone rubber is also said to be advantageous in making rubber rolls. X-1516 will conduct electricity and can be calendered and fabricated without losing its electrical conductivity, unlike conductive organic rubber.

Rolls made with X-1516 have been used in printing presses where they drain static charges. UCC believes there is no flexible, thermosetting material on the market today which can be fabricated to provide as high a degree of electrical conductivity as X-1516. Electrical resistivities of less than 100 ohm-cms. are obtainable.

High-temperature silicone rubber rolls are also being fabricated with UCC's K-1040 series. These compounds are "pre-conditioned" because the condition in which they are shipped needs only a minimum of mill freshening before fabrication.

Silicone rubber rolls are being used in the textile industry for the manufacture of non-woven cloth, and in the plastics industry for calendering molten polyethylene on to kraft paper.

Union Carbide declares that many uses of silicone rubber rolls are still unexplored "and only await creative minds to develop new applications."

Illustrated on these pages is the manufacture of a silicone rubber roll 52 inches long and eight inches in diameter. The original steel core was six inches in diameter. At the time of fabrication, the 800-pound silicone rubber roll was believed to be the largest of its type ever made in the United States. Since then Rodic has built a roll 85 inches long and 12 inches in diameter.

The manufacturing process consists of cleaning and priming the metal core, wrapping it with silicone rubber, steam curing, and grinding it to exact dimensions. The silicone rubber sheets are supplied by Union Carbide on a paper backing. The roll is built up sheet by sheet.

Fig. 6. Ground, sanded, and ready for shipment, the 52-inch-long roll is given a final check. Bond between steel core and silicone rubber excellent. Two inches of silicone rubber surround the six-inch-diameter core

Fig. 4. Removed from its axle, fabric-covered roll points toward maw of steam autoclave in which it will be vulcanized

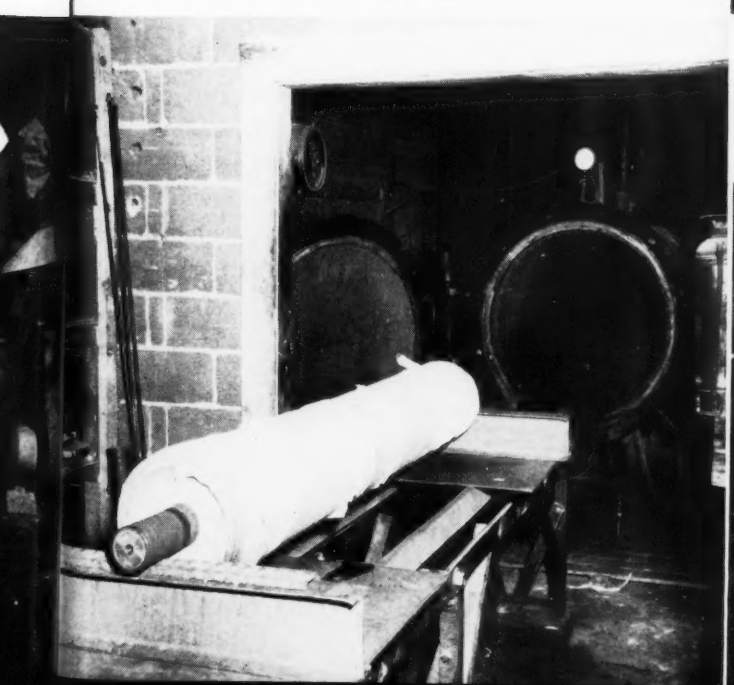
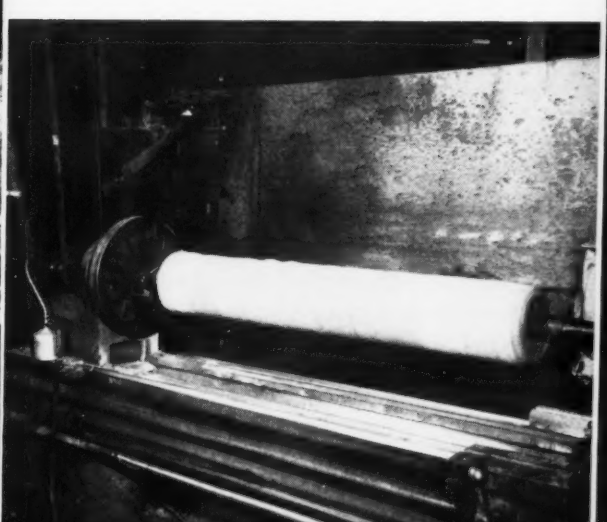


Fig. 5. Cured and stripped of its cotton wrapping, the unevenly surfaced roll will be ground down to specification by the grinding wheel on right. Overlap will also be cut



EDITORIAL

Today's Industry Requires More and Better Statistics

MORE frequent publication of more detailed and better organized statistics on the rubber products industry is an urgent need of that industry in view of its present and predicted future growth rate. Basic statistics for the industry are those of the Bureau of Census of the Department of Commerce, but the data in the 1954 Census of Manufactures are the first fully reported annual statistics since 1947, although the Bureau of Census has made annual estimates based on sample reports for 1950 through 1953.

In an analysis of the advance reports of the 1954 Census of Manufactures for the rubber products industry (the final reports are not yet available) by the Business & Defense Services Administration, Chemical & Rubber Division, in its publication "Chemical and Rubber—Industry Report" for October, 1956, important changes that have taken place in the industry between the 1947 and the 1954 Census are pointed out. *Of considerable special significance is the concluding paragraph of this analysis, which states*:

"The seemingly loose relation between price and volume of business has little significance because of the extensive changes from 1947 to 1954 in the material used, in compounding, and in products and quality. Direct comparison of statistics for the two years gives some idea of the magnitude of change, and provides a new and more recent picture of the status of various segments of the rubber industry."

In view of these "extensive changes" mentioned above, which are increasingly apparent to those intensively occupied day by day with this industry, there should be available fully reported annual statistics for the rubber products industry more frequently than every seven years, or even every five years. *The next Census of Manufactures is scheduled for 1958, but what is really needed is fully reported annual statistics every two or three years under present-day conditions.*

In addition, and possibly of even greater importance, is the need of modernization of the Census Bureau's "Standard Industrial Classifications," as applied to the rubber products industry. In the recent 1954 Census, the rubber products industry had only four major classifications, as follows: (1) tires and tubes, with an annual value of shipments of $1,621,917,000; (2) footwear, with shipments valued at $163,275,000; (3) reclaimed rubber, with $44,452,000; (4) rubber industries not elsewhere classified, with $1,743,519,000.

How many management executives, production managers, industry statisticians, and sales people think of the rubber products industry these days in terms of the four classifications now used by the Census Bureau? It must be admitted that the Bureau subdivides the "not elsewhere classified," or n. e. c., category into five further sub-classifications, one of which is, however, *"other rubber products, n. e. c."* One of the subclassifications, that is, "mechanical rubber goods," has 17 further subdivisions.

It would seem that "mechanical rubber goods" has now reached the status of a major product category and need no longer be vaguely referred to as "industries not elsewhere classified." The value of these mechanical rubber goods in the 1954 Census amounted to $1,100,459,000 of the $1,743,519,000 for the entire "not elsewhere classified" category. *Industry and the Bureau of Census should get together on this statistics problem now!*

R. G. Seaman

EDITOR

Meetings and Reports

Akron Group October Meeting Program Includes Symposium on Softeners

The program for the meeting of the Akron Rubber Group held at the Sheraton-Mayflower Hotel, Akron, O., October 26, included a symposium on "Softeners for the Compounding of Rubbers," at the afternoon technical session and a talk by Harrison Dillard, former Olympic champion on "Olympic Games," at the dinner-meeting. Harry M. Brubaker, Group chairman, presided at the afternoon and evening meetings. Attendance at the afternoon meeting was about 350 and about 600 at the dinner meeting.

A. E. Juve, The B. F. Goodrich Co., was the moderator for the panel discussion on softeners. The panelists and their subjects were as follows: S. S. Kurtz, Jr., Sun Oil Co., petroleum products; Lyle Amberg, Hercules Powder Co., pine products; Paul O. Powers, Pennsylvania Industrial Chemical Co., coal-tar products; and Max A. Pollack, Wallace-Tiernan Co., ester plasticizers. After an introduction to the symposium by the moderator, each of the panelists gave short talks on the type of softener assigned to him, and a question-and-answer period followed.

At the dinner-meeting Mr. Dillard first discussed the probable reorganization of the Cleveland Indians of the American League for 1957 and then mentioned many highlights in the Olympic games over the past few years. He outlined the origin of the games and made some pertinent comments on what United States teams and individuals had accomplished in them.

[*(General Tire) photo below*]
Chairman Juve and members of symposium panel

SOFTENERS FOR THE COMPOUNDING OF RUBBER

Introductory Remarks

By A. E. Juve

B. F. Goodrich Co., Brecksville, O.

THE term "softener" is one of the many terms used in the rubber industry which is not very clearly defined or clearly understood. The definition appearing in the recent ASTM "Glossary of Terms relating to Rubber and Rubber-Like Materials"[1] is as follows:

> "A material added in relatively small amount to a rubber compound to render the mix more plastic and so facilitate processing. Also a material added in larger amount to lower the hardness of the vulcanizate. Examples are pine tar, stearic acid, mineral and vegetable oil, esters and mineral rubber."

This definition is not entirely adequate, as will be apparent as we go along.

In practice the compounder is inclined to class any material which is liquid as a softener. A liquid accelerator or antioxidant, however, which will soften the batch is generally excluded. Also, chemical plasticizers which are added specifically to soften rubber are not generally classed as softeners. Certain materials, such as resins and waxes, which are solid at room temperature, are also called softeners.

The term "softener" would seem to imply that addition of such a material would produce a softening, either of the uncured mix or of the vulcanizate. Frequently it does both, but in special cases it does one and not the other.

That softeners as a class are important compounding ingredients, I think everyone recognizes. We are all familiar with the profound beneficial effects produced by softeners, particularly with respect to processing.

Statistics on the consumption of softeners in the industry are difficult to obtain, but, as best I could find, approximately 265,000 long tons of softeners are consumed per year in the rubber industry. This amount excludes fatty acids and resin acids present in styrene-butadiene rubber (SBR) which total approximately 37,000 long tons.

An attempt was made in obtaining the above figures to exclude plasticizers used with polyvinyl chloride, a large proportion of which is consumed by units of the rubber industry, but we wished to exclude consideration of this subject from this discussion. Calculated another way, for every 100 parts of rubber consumed about 15.5 parts of softener are used.

The specific purpose for which softeners are used are many including: (1) reduction in viscosity of the mix; (2) lubrication for extrusion or calendering; (3) tackifying; (4) detackifying; (5) as a diluent, (6) to lower the hardness of the vulcanizate; (7) to lower the freezing point of the vulcanizate; (8) to improve ozone resistance, as with waxes; (9) to activate the cure, as with fatty acids and pine tar; (10) to increase or decrease the coefficient of friction; (11) for reclaiming. Frequently the softener performs a dual or multiple function.

It was considered that this panel discussion might be organized on the basis of having an expert representing each of these functions for which softeners are employed, but there would hardly be room on this stage for all that would be required. A second plan, which was the one adopted, was to have one expert for each of the major classes of softeners based on source of the material. The classes chosen include petroleum products, pine products, coal-tar products, and ester-type plasticizers. This grouping excludes certain classes of materials, most of which are of minor importance including vegetable oils, phenolic resins, fatty acids, liquid rubbers, waxes other than those derived from petroleum, and a number of miscellaneous materials. Those materials, however, which are included in the four classes selected represent by far the major tonnage of softeners consumed.

[1]ASTM Special Technical Publication No. 184. American Society for Testing Materials, Philadelphia, Pa.

Petroleum Products

By Stewart S. Kurtz, Jr.

Sun Oil Co., Marcus Hook, Pa.

SOFTENERS and extenders of petroleum origin which are used in rubber include both solid and liquid materials. Asphalts, tars, resins, waxes, and oils are all used.

Rubber consists of long chain-like molecules linked together in the curing operation. Softeners provide internal lubrication which permits more freedom of motion of the chains relative to one another, in other words, less internal friction and less heat build-up.

Softeners, in general, are cheap relative to the polymer. There are, therefore, both economic and quality considerations which encourage the use of softeners. The practical problem is to find the right balance between cost and quality in the finished article which goes to the ultimate consumer. The old saying, "Pennywise is sometimes pound foolish," applies. Cheap oils can easily lead to poor products.

Asphalts

Where relatively little motion is involved and color is not important, as in some grades of floor tile and some grades of mechanical goods, extremely viscous materials such as asphalts and pitches are satisfactory as softeners. An ingenious mechanical goods compounder can hold together a lot of asphalt and filler with very little rubber.

A good many grades of asphalt are used in rubber compounding. For softeners, very soft asphalts, sometimes called asphaltums, are generally used. Where good resilience is desired, asphalts must, however, be used in very limited amounts, since the large sluggish molecules are relatively poor internal lubricants in the rubber mass.

Other solids, such as resins of petroleum origin and wax, are used as softeners. Dr. Powers will cover petroleum resins as well as resins from coal tar.

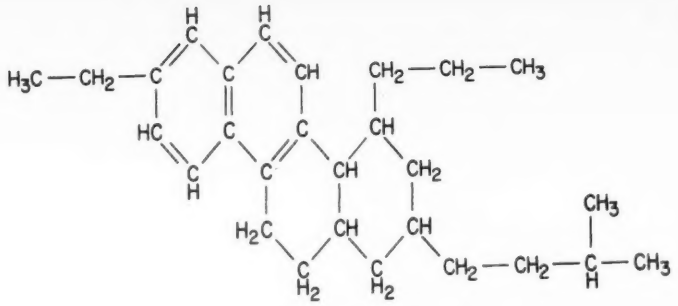


Fig. 1. Formula for Sundex 53

Wax

Wax is a petroleum oil which melts above room temperature. There is no precise definition of where oil stops and wax begins.

The pertinent point in regard to wax is its ability to crystallize as a thin film on the surface of cured rubber. For this reason it can be used to give protection against cracking when rubber is exposed, under static conditions, to air and sunlight.

Asphalts and wax are important in rubber compounding, but are used in much smaller volumes than processing oil. Last year about 200,000,000 pounds of petroleum oil were used in the rubber industry.

Processing Oils

The properties of the oil which go into the rubber are important. Oils of low molecular weight have low viscosity and are good internal lubricants, but may be too volatile. Oils of high molecular weight have high viscosity and may be less desirable as internal lubricants, but they are less volatile.

It is desirable, therefore, to use an oil of as low molecular weight as is consistent with volatility requirements. Molecular weight can be estimated from viscosity and gravity with sufficient accuracy for such comparisons. Flash point is a good control of the lowest boiling part of the oil.

Petroleum oils are made up of carbon atoms in aromatic rings, naphthenic rings and paraffin chains. Rapid methods are now available for getting the composition on this basis, which is called "carbon type analysis."[2-5]

An "average molecule" in one of our commercial rubber processing oils (Sundex 53) has 28 carbon atoms so arranged that there are 10 carbon atoms in the aromatic structure, 8 carbon atoms in the naphthenic structure, and 10 carbon atoms in the paraffinic structure. (See Figure 1.) On a carbon-type analysis basis such a molecule is 36% C_A, 28% C_N, and 36% C_P.

Commercial oils sold for use as softeners have a wide variety of composition, as discussed in our Cleveland paper,[3] which has been submitted for publication.

% C_A may vary from 0 to 50
% C_N may vary from 20 to 45
% C_P may vary from 20 to 75

In the case of the styrene-butadiene-type of copolymer, there is little tendency for oil of any type to bloom out at loadings up to 50 parts. Oils do vary, however, in the rate at which they are taken up in the Banbury. Carbon-type composition, we believe, correlates with this behavior.

Viscosity-gravity constant, low-temperature properties, oxidation stability, etc. are also related to carbon-type composition.

A very simple classification system[4] which works very well for oils has been published.

Viscosity in centistokes is plotted vertically on a log scale and is proportional to molecular weight. Viscosity-gravity constant, which is a function of composition, is plotted from left to right. This procedure sorts out oils both according to type and to molecular weight.

As an example of the use of this chart, we have spotted most of the rubber processing oils which are in use in the rub-

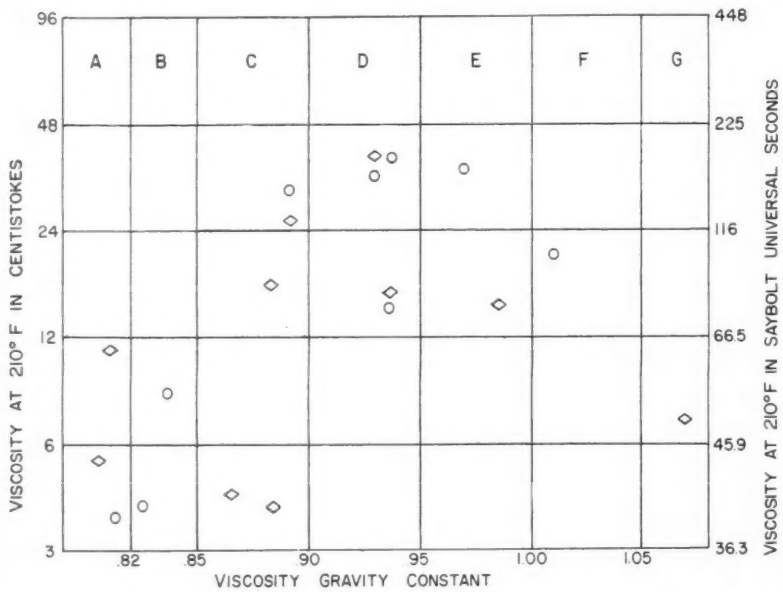


Fig. 2. Viscosity *versus* viscosity gravity constants for petroleum softeners

[2] S. S. Kurtz, Jr., C. C. Martin, India RUBBER WORLD, July, 1952, p. 495.

[3] S. S. Kurtz, Jr., R. W. King, J. S. Sweely, *Ind. Eng. Chem.*, Dec., 1956. S. S. Kurtz, Jr., R. W. King, W. J. Stout, D. G. Partikian, E. A. Skrabek, *Anal. Chem.*, Dec., 1956.

[4] Sun Oil Co. brochure, "Classification of Rubber Processing Oils" (1954).

[5] S. S. Kurtz, Jr., R. W. King, W. J. Stout, M. E. Peterkin, paper presented before Petroleum Division, ACS, Sept., 1956.

ber industry in substantial amounts, and a few of more extreme composition which are still somewhat experimental although commercially available. (See Figure 2.) The oils designated with diamonds are Sun Oil products.

The paraffinic oils, (V.G.C., .790-.820) are good for non-staining and good low-temperature properties, but are taken up slowly by the rubber. In other words, a relatively long time is required in the Banbury mixer to get homogeneity with paraffinic oils and SBR rubber.

Naphthenic oils (V.G.C. .850-.900) are good all-around oils. They incorporate reasonably well and are relatively good on low-temperature properties, color, oxidation resistance, etc. The very low viscosity oils, below six centistokes, are rather volatile. Very high viscosity oils produce oil-extended rubber which has poor low-temperature properties.

The relatively aromatic oils (V.G.C., .900-.950) incorporate faster, but the viscosity range which is also suitable in regard to both volatility and low temperatures is relatively narrow. Oils in this class are widely used both for oil-extended rubber and in compounding.

The aromatic oils (V.G.C. .950-1.000) are all relatively poor in regard to oxidative degradation and suffer either from being too volatile or too viscous at low temperatures. Oils having high viscosity at low temperature give poor low-temperature properties in rubber. Oils of this sort have special uses, as in Neoprene Type WHV, but our laboratory does not recommend them for general use in SBR.

The material which reacts most readily with 85% H_2SO_4 is of interest. This material is a mixture of basic nitrogen compounds and other reactive material of uncertain structure. By "basic nitrogen" we mean nitrogen compounds like amines which react easily with acid. We believe that this material is a probable source of variability both in regard to cure time and in regard to oxidation degradation. The less there is of this reactive material in a given oil the better.

With regard to Neoprene Type WHV and other relatively "oil resistant" polymers, extender oils can also be used in loadings up to 50 to 100 parts. With such oil-extended polymers, oil will migrate to the surface unless it is carefully selected. For such use an oil should be very high in aromatic ring carbons on a carbon-type analysis basis. It should also be low in truly saturated molecules which can be determined by silica gel.

Oils act as internal lubricants in polymers. The oil for use in oil-extended rubber should be carefully selected, with molecular weight and volatility; carbon-type composition and processibility; low-temperature properties; oxidation resistance to minimize oxidative degradation, etc. kept in mind.

Modern methods for the analysis and characterization of oils provide much information and require relatively simple laboratory data: namely, viscosity, gravity, and refractive index.

Pine Products

By L. O. Amberg

Hercules Powder Co., Wilmington, Del.

THERE are three commercially important sources of rosin and terpene chemicals. These are the living tree, the pulpwood and paper industry, and aged pine stumps. In addition, another familiar natural rubber softener, pine tar, is obtained from pine-tree wood.

The living tree yields gum rosin and gum turpentine. The most important species is the fast-growing slash pine of southern USA. Gum rosin production methods resemble those for natural rubber. V-shaped incisions are cut in the trunk of the tree, and the exudate, called "crude gum turpentine," is collected in containers much as rubber latex is gathered. The rosin is then separated from the turpentine "spirits" by distillation. Because of the large amount of labor used, and the increasing cost of labor, this source of pine products is steadily decreasing in importance.

One of the by-products of the pulp and paper industry is tall oil, which contains very nearly equal parts rosin and fatty acids. Tall oil soap is separated from the effluent cooked liquors resulting from the alkali-treated shredded pine wood—the pulp—and cooked with mineral acid to obtain crude tall oil. The rosin can be separated from the fatty acids by any one of a number of processes.

The third major source of rosin and terpene chemicals is aged long-leaf pine stumps. After the stumps have remained in the ground for about ten years, the bark and sapwood have largely disintegrated, leaving the heartwood, which is the portion rich in rosin and terpenes. The properly aged stumps are pulled from the ground with highly specialized stump pullers and transported by truck or train to centralized processing plants where rosin and terpenes are recovered through an extraction process. The clearing of cutover pine land serves a useful purpose in that it restores the land for agricultural use or for reforestation.

Pine Tar

Pine tar has long been made by destructive distillation of pine wood. It is so closely associated with natural rubber products that it has been said that during World War II it was found there was little consumer resistance to the new styrene-butadiene rubber tires if enough pine tar was incorporated to make them "smell like rubber."

Pine tar is an excellent softener and processing aid for natural rubber in applications where some discoloration can be tolerated.

In keeping with modern technology, the primary rosin and terpenes are only the starting point for a group of widely diversified end-products. A substantial number of these end-products is helpful in some way to the rubber industry.

Although rosin as such finds some use in the rubber industry, it is made into far more useful products through chemical modification. For example, the undesirable effects of ordinary rosin on the aging resistance of rubber, and particularly natural rubber on outdoor aging, are eliminated by stabilization through modification of the abietic-type rosin acids.

Modified Pine Tar

Modification commercially available are dehydroabietic acid in which the unsaturation appears within an aromatic ring, which is more stable, or dihydroabietic acid in which less unsaturation is present. The abietic-type acid in rosin may be converted to dehydroabietic acid by heating in the presence of a catalyst, or to dihydroabietic by hydrogenation. The resulting increased stability of these materials is seen in the reduced amount of oxygen absorbed by the stabilized rosins as compared with unmodified rosins. Ordinary rosin absorbs about 10% of its own weight of oxygen when exposed in finely pulverized form under pressure at room temperature for a week. On the other hand, the stabilized rosins absorb only a fraction of 1% oxygen under the same conditions. To the rubber compounder, this reduction in oxygen absorption means better resistance to deterioration, especially in natural rubber.

Laboratory tests and practical experience leave little doubt that unmodified wood rosin and gum rosin may contribute to exposure cracking of natural rubber while the stabilized rosins are at least as good as a control without rosin. The normal outdoor exposure of natural rubber containing the rosins quite readily demonstrates the advantages of stabilization. We have not been able, however, to simulate these effects employing the usual accelerated test methods. A quite elaborate program comparing these and other materials under accelerated aging conditions, including the oxygen bomb and air-oven techniques, failed to show any consistent differences among stabilized rosins and ordinary rosins. This failure of laboratory tests to correlate with service life in the case of rosin and stabilized rosins has contributed to some confusion concerning the relative effects of these materials.

Applications

The principal values of stabilized rosins in rubber compounding are as pigment dispersing agents, processing aids, and tackifiers, as well as plasticizer-extenders for rubber compounds. These rosins are used, for example, in substantial quantity in tire compounding for both black and white sidewall tires. In the white-wall tires they are used not only in the white sidewall portion, but also in the backing stock because of their complete lack of coloring and staining.

Stabilized rosins find uses in many other kinds of rubber compositions including mechanical goods, surgicals, drug sundries, and household specialties. One substantial outlet is in floor tile where these rosins are used in quantities up to about 10 parts on the polymer. They contribute very usefully to the rate and degree of dispersion of the high pigment loadings. A special modification of a stabilized rosin is Hercules "Resin 913." It has similar properties except that the mild cure-retarding effect

of resin acids has been obviated; it also is well suited for floor tile applications.

One of the special properties of the stabilized rosins is their ability to make uncured and semi-cured compounds exceedingly extensible. This property of hydrogenated rosin is used in sponge rubber compositions where it imparts a stringy kind of tenacity to uncured and semi-cured compounds. This property, plus the pigment dispersing ability of the stabilized resin, results in a larger number of smaller pores in sponge rubber with a given amount of blowing agent; or conversely, more uniform pores of a given size with less blowing agent. Rosin acids should allow reduction or complete omission of acid activators for blowing agents where they are required.

An advantage of hydrogenated rosin, is that, when used with hydrated calcium silicate filler, it gives a measure of the reinforcement of high styrene resins.

Dimerized Rosin

So far we have discussed rosins made useful by disproportionation or hydrogenation. There is, however, another modification of rosin which yields a product peculiarly useful to the rubber compounder. Under proper conditions, rosin may be partially dimerized to give an increased melting point and reduced oxygen absorption compared to resin. As "Polypale"[6] resin for example, polymerized rosin is used in compositions where same extra hardness of compound is desired.

Polymerized rosin is treated further to yield a material which consists primarily of dimeric rosin acids. As in the case of disproportionation, dimerization also reduced oxygen absorption to a fraction of the absorption shown by rosin. Such a material is commercially produced as "Dymerex"[6] resin. Use of this material as a rubber compounding resin is steadily developing. Even though it is essentially a rosin whose molecular weight has been no more than doubled by dimerization (to about 650), it will perform some of the functions of very high molecular weight high-styrene-butadiene resins with many times its molecular weight. At the same time the cost of "Dymerex" is less than half that of high-styrene resins.

Other Rosin Products

One of the materials which can be obtained from aged pine stumps is the gasoline-insoluble fraction, "Vinsol."[6] This low-cost resin is very compatible with nitrile rubber compounds and is a useful product where neither low-temperature properties nor color is a critical limiting property. Probably because of its phenolic content, "Vinsol" can be used to give improved high-temperature resistance. Since, compared with other plasticizers, "Vinsol" can be utilized in quite large quantities, this resin can be used to reduce the costs of nitrile rubber compositions having good aliphatic hydrocarbon resistance.

While "Vinsol" is somewhat limited in its use in the hydrocarbon rubbers, quite satisfactory compositions can be made provided a second plasticizer such as "Dutrex" 22[7] is included with the "Vinsol" to act as a cosolvent.

Terpenes (such as dipentene) are liquids and are used in rubber compounding as softeners, and as processing aids. They also effectively promote pigment dispersion. One of the important uses of terpene softeners is in rubber reclaiming. They are especially valuable in non-staining reclaims; for example, in automotive floor mats they allow the use of light-colored decorative coatings because they do not discolor on migration.

Summary

Pine products, chiefly pine tar and rosin and terpene chemicals, contribute substantially to supplying the requirements of the rubber compounder. By hydrogenation, disproportionation, or polymerization, rosin may be stabilized so that it can be used in oxidation-resistant rubber compounds. Hydrogenation and disproportionation yield resins which are useful as softeners, tackifiers, processing aids, and dispersing agents in a multitude of rubber compounds, ranging from heavy-duty truck tires to the lightest-colored rubber tile on a kitchen floor. Polymerization of rosin results in a reinforcing resin which is used to impart rigidity to rubber floor tile and shoe soles.

A gasoline-insoluble resin which is a coproduct with wood rosin may be used to impart elevated-temperature aging resistance and lower cost to nitrile rubber compounds where color and low-temperature flexibility are not limiting factors.

In addition to being softeners, terpene solvents are used to promote pigment dispersion. They also are used in the manufacture of reclaiming rubber.

[6]Hercules Powder Co.
[7]Shell Chemical Co., New York, N. Y.
[8]Pennsylvania Industrial Chemical Corp.

Coal Tar and Polymerized Products

By P. O. Powers

Pennsylvania Industrial Chemical Corp., Clairton, Pa.

COAL-TAR pitches were among the early softeners used with rubber, but they have largely been replaced by other hydrocarbon material, often not derived from coal tar. Selected raw materials from coal tar, petroleum, or other sources are polymerized to produce softeners with controlled properties.

Coal-tar softeners are available in a variety of color grades and as soft or hard resins. These materials are entirely aromatic in structure, but will vary somewhat in the properties they impart to a rubber compound, depending on softening point and solubility characteristics. These softeners work well with nitrile type rubbers and with neoprene.

The aromatic softeners also are available as viscous liquids, up to 248° F. softening point resins, and from quite dark to pale materials. These resins have a high aromatic content, but are not so aromatic as the coal-tar resins, and some of these aromatic softeners can be used with oil-resistant rubbers.

The non-aromatic polymers are available only in lighter colors and cannot be used with oil-resistant rubbers. They work well, however, with natural and styrene-butadiene type rubbers. Polyterpene resins behave in a similar manner.

The earlier discussion has shown the effects associated with aromatic and naphthenic structure. The trends revealed these can be extended, since the spectrum of structures available in coal-tar and polymeric softeners are much wider than in the softeners available from petroleum oils, since materials containing entirely aromatic structure or totally devoid of aromatic structure are available. Also, the softeners can be produced in a wide range of molecular weights.

The aromatic resins are the most efficient and active softeners. They impart greater strength and greater resistance to cut growth than the naphthenic or paraffinic softeners, particularly in mechanical goods. The improvement in physical properties in non-black stocks with resins of this type is well known and is pronounced. The limiting factor in the use of these resins is the brittle point and rigidity of the compounds. Another detrimental effect is the rather poor light stability of these aromatic resins.

The naphthenic resins are well exemplified by polyterpene resins. These resins are particularly useful to increase the tack of natural rubber. They are often used where good color stability is essential. Another resin entirely devoid of aromatic structure is Piccopale.[8] This resin readily softens natural and styrene-butadiene rubber.

There is no doubt coal-tar and polymeric softeners could be used as softeners for oil-extended synthetic rubber with advantage. Price factors, however, may rule out the use of large amounts of these materials. They should be considered as modifiers of petroleum products.

Coal-tar resins are widely used in flooring, both as softeners for the synthetic rubber and with the high styrene-butadiene resins used in this field. The choice of the resin can be greatly modified by the solubility of the resin employed, and high modulus, high durometer stocks can be obtained by the use of less soluble resins. Monomeric styrene is frequently used as a component of such resins.

The coal tar and aromatic resins are also used in soling, and, here again, the solubility of the resin, measured by the cloud point, greatly affects the properties of the compound. Resin solubility gives a control of the hardness of the stock. Piccopale also has been used in soling, particularly because of its light color.

In the reclaiming of rubber a wide variety of softeners is used, raging from volatile coal-tar hydrocarbon up to fairly high melting resins, and all types of materials are presently employed in this field. Resinous materials, particularly the aromatic type, are employed because of the better physical properties obtained in their presence. Both aromatic and non-aromatic materials are widely used in this type of application.

Ester Plasticizers

By Maxwell A. Pollack

Harchem Division, Wallace & Tiernan, Inc., Belleville, N. J.

IT IS my pleasure to talk to you today about the special breed of softeners known as ester plasticizers. These materials are entirely synthetic and are made by reacting alcohols with acids. The alcohols and acids are available primarily from the organic chemical industry and include such alcohols as butyl, hexyl, octyl, capryl, glycol and glycol ethers, and such acids as sebacic, adipic, azelaic, phthalic, phosphoric, and octanoic. By combining these and similar materials in different ways, literally thousands of different esters can be produced. Of these, about 60 have become commercially important as plasticizers. In 1939 the total production of plasticizers in this country was about 30 million pounds. This business has grown since that time, to the point where last year some 400 million pounds were produced. It does not look as if the end of this growth is in sight.

Plasticizers perform a great many roles in industry, and one of the most dramatic and important jobs they do is the way they make a hard, horny plastic like polyvinyl chloride highly flexible and elastic. When plasticizers are used with rubber, their effects are not that striking, and their main job is to make better elastomers out of good ones.

The role that ester plasticizers play in rubber is for the most part a rather limited one. This restriction is due mainly to their higher prices as compared with other softeners, and they are used only where their superior performance is absolutely essential. Perhaps their most important quality is their ability to keep rubbers from stiffening at extremely low temperatures.

This property is vital for uses in the Arctic regions or in aircraft operating at high altitudes. Most rubbers will lose some measure of softness, resilience, and elasticity under such conditions, and some rubbers are much more seriously affected than others. In particular, the nitrile rubbers and polychloroprene often depend upon ester plasticizers to improve their low-temperature properties.

Why should anyone pay 30, 50, or even 70¢ a pound for ester plasticizers, when he can choose from a wide variety of other softeners which cost less than 10¢ a pound? Obviously, because the cheaper products just won't do the same job. What, then, are the special features of ester plasticizers that make them so useful?

Compatibility

Compatibility is one important special feature. When you have an oil-resistant rubber, obviously you can't use just ordinary oils to plasticize it. What can you use? Well, you go back to a basic rule for compatibility—like attracts like. Since oil-resistant rubbers are distinguished by their content of highly polar structures, such as nitrile and chlorine groups, we look for plasticizers among those compounds which also contain highly polar groups. Since the ester group is highly polar and conveniently produced in industry, we certainly take a long look at esters. We find that when we add ester plasticizers to polar rubbers, there is a mutual attraction set up between the ester groups of the plasticizers and the polar structures of the rubbers. This attraction keeps the plasticizer from bleeding out, which is what would happen if we tried to use most hydrocarbon oils as plasticizers.

Permanence

Permanence is another important and special feature. Any products that we want to use as plasticizers must stay in the goods for the expected useful life of the article, or they aren't any good. This means that first of all, they must be of high enough molecular weight so that they will not be lost by volatilization either during processing or during use. The minimum requirement for this varies according to the application, but most ester plasticizers for rubber have molecular weights of 300 or higher.

There are many ways in which a synthetic molecule can be put together to give a molecular weight of around 300. For example, we might take sebacic acid, which has a molecular weight of 202, and esterify it with two molecules of butyl alcohol, which has a molecular weight of 74. In this process two molecules of water are split out, and we wind up with the plasticizer dibutyl sebacate, which has a molecular weight of 314.

If our application is one demanding outstanding resistance to heat, we might look at plasticizers with molecular weights around 400. To achieve this, we could for example take sebacic acid and esterify it with octyl alcohol, which has a higher molecular weight than butyl alcohol. In this way, we would produce dioctyl sebacate, with a molecular weight of 426.

Suppose we should require outstanding resistance to extraction by solvents. To achieve this quality, we might need to go to molecular weights of 2,000 or more. One way to do this is to esterify sebacic acid with a glycol. The use of a glycol instead of a simple alcohol permits the esterification reaction to continue until a polymeric plasticizer is produced of the desired molecular length to make it resistant to extraction.

As you can see, one of the great benefits we get from the synthetic chemical industry is that it makes available so many raw materials that one can almost (and please note that word "almost") tailor-make a plasticizer to suit a specific requirement. One thing to keep in mind in the production of high molecular weight plasticizers is that it isn't enough just to choose high molecular weight ingredients. It is also necessary to insure that the selection of ingredients and the ways they are put together maintain the proper balance of polar and non-polar groups so that other properties such as compatibility and efficiency are not lost.

Low-Temperature Service

When it comes to low-temperature performance, ester plasticizers range from very poor to outstandingly good. A lot of work has been done trying to understand what is necessary for outstanding low-temperature performance. Undoubtedly several factors are involved, and perhaps the most important of these is the viscosity of the plasticizer. If you examine the low-temperature performance of plasticized rubbers, you find that the lower the viscosity of the plasticizer the better the low-temperature results.

The physical basis for this is not hard to understand. Today it is generally recognized that the elastic properties of rubber are best explained on the basis that the molecules are in violent agitation. This behavior is directly attributed to the energy of the heat in the system. When the temperature is lowered, the forces acting on the rubber molecules are reduced, and the movements of the latter become sluggish. This phenomenon is particularly noticeable with those molecules which have "hooks" on them, such as the polar structures in the oil-resistant rubbers.

To get away from this sluggishness and make the rubbers more elastic and resilient, we add plasticizers. If the plasticizers are viscous liquids, we haven't helped the situation much, and the movements of the rubber molecules are still slow and hampered. If, however, we select very thin liquids as plasticizers, then the rubber molecules can move about quite freely.

Well, then, it seems that we have simplified our problem. When we want low-temperature performance, all we need to do is use thin liquids as plasticizers. This is only part of the story, however, because if we take a group of liquids with equally low viscosity at room temperature and chill them, we will find that some will solidify, and among those that remain liquid, some will thicken much more than the others. Ideally what we would like to have are liquids that will not thicken at all at low temperatures.

We can measure the degree of thickening by the viscosity index, which is simply an inverse type of ratio of the viscosity of a liquid at two different temperatures. In industry, we recognize as most desirable those plasticizers of highest viscosity index, for these show the least change of viscosity with temperature.

Our first thought about any plasticizer which freezes solid at, say, ice temperature is that it couldn't be any good as a plasticizer at —65° F. The actual facts may belie this, however, and we find that if the plasticizer is compatible with the rubber, its behavior in the rubber bears no relation to its freezing point in the pure state. One analogy might be salt dissolved in water. Although salt has a melting point of about 1500° F, it markedly lowers the freezing point of water when it is dissolved.

Many other problems and requirements, of course, are involved in the selection and the use of plasticizers, and in a short talk like this, it is impossible to do more than hint at them. We have mentioned some of the special features of ester plasticizers, particularly those which are good for low-temperature work. Some of the more important plasticizers used in rubber for improvement of low-temperature performance include dibutyl sebacate, dioctyl adipate, dibutyl phthalate, tributoxy-ethyl phosphate, trioctyl phosphate, butyl oleate,

di-isobutyl adipate, TP90B,[9] Plasticizer SC,[10] and Harflex 500.[11]

The plasticizer industry is young and fast-growing, and new products are being born at a healthy rate. We are going to need these new products and also a better understanding of how to use our older materials to keep pace with the growth of the rubber industry. Working together, we hope that we can help make this growth not only healthy and profitable, but also enjoyable and satisfying.

Questions and Answers

Q. Which type of petroleum softener, highly aromatic or highly paraffinic, gives the best tread crack resistance in SBR treads?

A. Kurtz. Primary factors are tread design and the temperature to which the tread is cooled before the tire is broken out of the mold. Cracks can be started right there before the tire ever gets on a wheel.

Assuming that the tread design and curing are properly done, then, I believe, that the best way to avoid tread cracking and also crack growth is to keep the stock as soft as is practical without getting into tread wear trouble. This approach is in line with the paper presented by Auer and Schaffner,[12] of United States Rubber Co., at the Atlantic City meeting of the Rubber Division, ACS, which showed that low modulus and high elongation at break usually give low crack growth.

Tread cracking and crack growth are probably an oxidation effect promoted by local stress and susceptibility to oxidation. A soft stock reduces local stresses; an oxidation-resistant oil gives some protection on the oxidation side.

All aspects of a compound must be considered in the study of crack resistance. We recommend compounding and curing to a relatively soft stock using an oil relatively resistant to oxidation.

Highly paraffinic oils are hardly practical because of processing and tack trouble. Naphthenic oils are good for use in tread compounds. Aromatic oils are more liable to oxidize, but have been said to be satisfactory in regard to crack growth in soft stock.

Q. What mixing procedure will give best dispersion of a tread compound (natural rubber) when using (a) petroleum, (b) pine-tar softeners?

Also, discuss the effect of carbon black dispersion of (1) various types of softeners, (2) time of addition of softeners to the batch.

A. Amberg. Largely independent of the choice of softener, the best pigment dispersion is obtained by keeping the viscosity of the mix as high as is practical until after the incorporation of pigments. Also, the pigment wetting effects of the softener (especially one of the pine products such as pine tar or hydrogenated rosin) are helpful in obtaining the best dispersions. A compromise often is made in which part of the softener is added to the mixer on top of the polymer and the remainder on top of the pigment loading.

Q. From the standpoint of the varying characteristics desired in finished rubber compounds, do you think it would be possible to have a "universal" softener? What would its characteristics have to be? If a "universal" softener could be developed, would the cost factor be minimized?

A. Kurtz. The nearest thing we have to a "universal" softener is an oil with V.G.C. between .850 and .900 and viscosity between 12 and 24 centistokes at 210° F. (66 to 116 Saybolt Universal Viscosity 210° F.) Such an oil can be used for a wide variety of applications. This does not make it a universal softener.

There would not be four panelists here today if a wide variety of softeners were not needed.

Q. What softener or combination of softeners is recommended for nitrile rubber compounds to provide (a) maximum uncured tack, (b) maximum uncured adhesion, and (c) minimum plasticity and maximum recovery?

A. Pollack. For good uncured tack and cured adhesion, I would suggest the highly aromatic softeners, preferably of the higher molecular weights. For minimum plasticity and maximum recovery, the low-viscosity ester plasticizers would be best. The specific products in each of these classes that would be best for any particular job would depend on such factors as compound cost, softener level, design of product, and service required.

Q. What low-temperature plasticizer can be used in conjunction with styrene-butadiene carcass stocks which will impart some building tack?

A. Powers. In this case we believe the final result will be a compromise. Coal-tar resin should be used in amounts to give the required tack, but not in sufficient amounts to affect the low-temperature properties. The result will be a balance between the two properties desired.

Q. When high oil loadings are employed in tire treads, does blending of different oils prove beneficial, and what are the recommended types?

A. Kurtz. We recommend for high oil loadings the more oxidation resistant and less viscous oils in the .850 to .950 V.G.C. range.

If a highly aromatic oil is used in the base polymers, we recommend that any additional oil added in compounding be of the naphthenic or even paraffinic type, to improve the average oxidation resistance and low-temperature properties of the final compound.

Q. What type of softener is best to prevent camelback from increasing in Mooney viscosity value on aging?

A. Amberg. Assuming that a curative system with good stability on storage is provided, incorporation of a stabilized rosin-type softener would be expected to improve scorch resistance both during processing and on long-term storage.

Q. Do any plasticizers enhance (increase) electrical conductivity in rubber?

A. Juve. In natural rubber, SBR, and the nitrile rubbers, plasticizers would be expected to have little effect on conductivity except in those cases in which high conductivity had been attained by the use of conducting blacks when they would be expected to have an adverse effect, i.e., increase resistance.

In neoprene where the conductivity in stocks not pigmented with carbon blacks is due to ionic conductance, the addition of plasticizers should lower the resistance. In carbon black stocks, however, the effect is likely to be adverse.

Specific plasticizers which might enhance conductivity would be halogen-containing materials in which the halogen is unstable. A stable halogen-containing plasticizer should have little effect on conductivity.

Q. What are the relative tendencies toward migration into adjacent compounds of commonly used tire compound softeners, particularly those used in oil-extended polymers; and if a natural rubber carcass compound is cured next to an oil-extended tread, how much is the oxidation resistance of the natural rubber compound affected by the oil migration? Are some oils worse in this respect than others?

A. Kurtz. Since softeners act as lubricants between adjacent rubber molecules and do not form chemical bonds, migration can occur with any of the softeners used with tires. This migration is probably a slow process and is influenced by the viscosity of the oil and the time and temperature history of the tire. It is reasonable to expect that the plasticizers which have the lowest molecular weight and viscosity will migrate fastest.

With regard to oxidation resistance of either natural or synthetic rubber, oils with medium or low aromatic carbons are better. In other words, the less chemically reactive material the better. In terms of the Rostler[13] method of analysis, the less the nitrogen bases the better. The manner in which natural rubber is compounded is also important.

When natural rubber is used in breaker strips, it is good practice to compound this to withstand softening effects caused by migration.

Q. Why does the use of some softeners (resins) affect the mill roll to which a stock will run? That is, the stock can be made to run on either the fast or the slow roll by proper selection of softener.

A. Amberg. It is true that for a given set of conditions, softeners often may be selected which will determine which roll the stock will run on. However, friction ratio, temperature, and temperature differential also have effects. In turn, these effects vary, depending on the individual softener. Knowing that these factors exist, an experienced operator usually can put a stock on the correct roll regardless of the softener.

A. Powers. It is a little difficult to become too general on the reasons for the batch following one roll or the other. It

[9]Thiokol Chemical Corp., Trenton, N. J.
[10]Harwick Standard Chemical Co., Akron, O.
[11]Harchem Division, Wallace & Tiernan, Inc.
[12]RUBBER WORLD, Aug., 1956, p. 723 (abstract only).
[13]F. S. Rostler, H. W. Sternberg, *Ind. Eng. Chem.*, 598 (1949). F. S. Rostler, R. M. White, *Rubber Age* (N. Y.), 70, 735 (1952).

is at least in part a matter of temperature and the temperature viscosity characteristics of the particular resin. Coal-tar resins and aromatic resins, in general, have a rather steep viscosity temperature gradient and may go through the sticky range at a rather narrow temperature level. The non-aromatic materials are somewhat less temperature susceptible and, in general, tend to have a wider range of temperatures where they become tacky.

Q. What properties of oils affect physical properties of rubber compounds? For example, low viscosity light-process oils tend to produce higher modulus values in natural rubber compounds than do higher viscosity aromatic softeners.

A. Kurtz. This is an odd question. To the best of our knowledge a low viscosity light-process oil will give a lower modulus stock than a more viscous oil. The only reversals I know of are where the oil is so volatile that it is lost by evaporation. In such a case, enough light oil may be lost to make a substantial difference in the amount of oil present.

At equal volume oil loading and equal cure, the more viscous oil will usually give the higher modulus, higher tensile, and usually the lower elongation at break. Viscosities for this purpose should be compared at the temperature at which the rubber will be tested.

For good low-temperature properties a light paraffinic oil is best. Naphthenic oils are better than aromatic oils at low temperature.

Q. Passenger treads with cap and base construction employing a typical cold rubber tread will permit how much oil extension in the base?

A. Kurtz. We have been told that it is practical to use a 50-50 blend of regular styrene-butadiene rubber and 37½ parts oil-extended rubber in the base.

Q. Discuss applicability of various plasticizers to nitrile rubbers.

A. Pollack. As indicated previously, ester plasticizers are used in nitrile rubbers primarily for two reasons: one, for improvement of low-temperature performance; the other for resistance to extraction by solvents and other media. Low-viscosity esters are used for the low-temperature work, and, in addition, these esters usually impart to the stock high resilience, low compression set, high elongation, and low durometer hardness. For good resistance to extraction, the polymeric esters are used, and these tend to give high durometer hardness, poorer resilience, and outstanding heat service.

Q. Does it look as if pine products such as pine tar and pine oil will continue to be available, and at what price levels?

A. Amberg. First, I have been assured that there is an ample long-range supply of the basic raw materials—pine wood, pine stumps, and tall oil.

Second, I have been assured with equal firmness that the producers of pine products intend to remain in business. Wood-gathering methods have advanced so that it is now practical to clear land that previously could not be cleared economically. It is to be expected that further improvements in harvesting methods will, in turn, result in utilization of areas not now worth working.

Looking back over the last 10 years to check trends in domestic production capacity, we find the supply of wood and gum rosin maintained at the 1,000-million pound level. The figures for pine tar show sustained production of about five million gallons per year during the same period. The terpene products which are produced along with pine tar and rosin were similarly stable in production.

Temporary shortages of pine products in the past always have been corrected by the laws of supply and demand. Rapid changes in the requirements of the industry may, as in the past, create temporary unbalances. From the long-term view, however, it is reasonable to expect that demand will continue to determine the availability of pine products. The same demand will have a part in determining price levels. Pine products must, of course, remain competitive in price with other types of softeners.

Q. Has the use of high softener ratio proved satisfactory for oil-extended polymer usage in carcass compounds, and what ratio per hundred parts total polymer is practical?

A. Kurtz. Comparatively little oil-extended rubber is now used in carcass construction. An equilibrium will develop, however, between the oil in the tread and the carcass compound. We would not, at this point, rule out the use of a little oil-extended rubber in carcass compounds.

Q. What tests are most critical in indicating the uniformity of softeners?

A. Powers. The most critical test in indicating the uniformity of coal-tar and polymeric softeners is the softening point and the density. Since these materials are made from selected stocks under controlled manufacturing conditions, they are quite uniform in properties, and a specification of the density and melting point should insure uniform products for the various commercial types.

A. Pollack. For esters, we use the specific gravity, color, actual analysis for ester content, and usually include tests for residual unreacted acids and alcohol. Additional tests, if required, might include viscosity and refractive index.

A. Amberg. Acid number and melting point ordinarily are sufficient tests for establishing the uniformity of rosins; while specific gravity, boiling range, and refractive index are used as control tests for terpenes. I have been informed that the best tests for pine tar are viscosity, specific gravity, and moisture content. Carefully controlled production of pine products insures very uniform products, and these tests should be sufficient.

A. Kurtz. Processing oils for the rubber trade are closely controlled for uniformity by manufacturing specifications. Properties we consider important are viscosity, gravity, color, aniline point, and flash point, all of which may be easily obtained in the laboratory. These properties are controlled during manufacture and can be used to characterize oil as to type. Additional data which are sometimes useful are: refractive index, from which carbon-type composition can be obtained; and 85% H_2SO_4 extractables if degradation effects in polymers are under consideration.

Q. What softeners are best for oil-extended rubber, both in extending the rubber and also in compounding the extended rubber?

A. Kurtz. The first part of this question has been covered in the introductory remarks.

In compounding oil-extended rubber, we recommend adding additional oil which has the least tendency for oxidative degradation; specifically, a naphthenic oil of satisfactory viscosity, volatility, and color.

Q. What type of softeners give best aged properties to rubber?

A. Amberg. It is most likely that the effect of softeners on aging resistance is associated with the varying tendency of the materials to enter into a three-way interaction with oxygen of the air and the polymer molecule. Modern technology has created softeners in all four classes which are oxidation resistant and which, therefore, give good aged properties to rubber compounds.

Q. What group of plasticizers is best for flex resistance of natural rubber compounds, and how do polymerized oils affect flex resistance of natural rubber compounds?

A. Powers. In general, aromatic resins improve the flex resistance of natural rubber compounds.

Q. How high a ratio of oil-extended polymer is advisable when blended with natural rubber for commercial truck tires?

A. Kurtz. So far as we know, oil-extended rubber has been used in blends up to 50% in small- and medium-size truck tires. In large truck or bus tires, so far as we know, oil-extended rubber is not used.

Q. Give effect of various softeners on these properties of tread stocks: (a) rate of cure; (b) aging; (c) cut resistance.

Also, how do the four classes of softeners compare for resistance to (a) oven aging and (b) oxygen bomb aging of a natural rubber body stock.

A. Amberg. The rate of cure of most natural and synthetic rubber compounds is somewhat slower when the rosin-derived resins are used. Experience has shown, however, that when accelerator level is increased to compensate for the slower cure, the resulting compound usually has improved processing safety compared with those containing non-rosin compounds. We have observed in the laboratory that, discounting diluting effects, the petroleum products are about neutral; while some coal products accelerate slightly, and some retard to a very small degree.

I assume that cut resistance refers to cut growth of synthetic rubber treads on flexing. Our laboratory tests consistently show an advantage for rosin-derived softeners over non-rosin types after the test samples have been hot-air aged to simulate the effect of hot running of tires. This result probably reflects an observed improvement in retention of elongation on hot-air exposure.

As I mentioned in the preliminary dis-

cussion, we have not been very successful in using the air oven or the oxygen bomb to demonstrate any important differences among the rosin-derived softeners (and a few non-rosin materials used as controls) in natural rubber compounds. In the answer to another question I discussed the effect of reactivity with oxygen on practical outdoor exposure resistance of natural rubber compounds.

Q. What is the best type and amount of softener for natural rubber treads and synthetic rubber treads?

A. Kurtz. Natural rubber will take 4-5 parts of either pine tar or petroleum oil without difficulty. Thirty years ago pine tar was definitely the preferred softener. Now less distinction is made between pine tar and petroleum oils.

Some work has been done with oil loadings above 5% and with high black loadings in natural rubber; I am not sure how practical this is.

For styrene-butadiene rubber treads, we believe that best results are obtained with high Mooney viscosity cold rubber extended with an oil in the .850 to .950 V.G.C. range such as Circosol 2XH[14] or Sundex 53.[14] Up to 37½ parts oil on polymer (27 in extended polymer) is satisfactory in the smaller tires.

For non-oil extended synthetic rubber treads the oil is used in the range of 5-15 parts.

In large tires such as truck and bus tires, natural rubber is preferred. In small tires oil-extended synthetic rubber is very satisfactory. Treads of intermediate-size tires are often blends of natural and synthetic rubber and are also intermediate in softener content.

Q. Give the general compounds to which each of the four types of softeners is most applicable and the most distinctive compound property imparted by each type.

A. Kurtz. Petroleum softeners can be used in natural rubber, styrene-butadiene rubber, neoprene, and nitrile rubbers. The amount of petroleum oil used in natural rubber is of the order of 5%; whereas in high Mooney viscosity styrene-butadiene rubber 27% (37½ parts) can easily be used. In regular neoprene a low molecular weight naphthenic oil has been standard for years. In high Mooney viscosity neoprene more aromatic oils are needed.

Petroleum products are used in all types of rubber compounds, both flexible and non-flexible. From our viewpoint two distinctive effects are imparted by their use. These are their ability to aid processing during mixing and subsequent fabrication such as extrusion; and, to maintain a good overall balance of physical properties in the end-product. The properties desired in the finished article, of course, dictate which of the many types of softeners are best suited for the application.

Not to be overlooked is the use of oils as extenders in low-cost items. In these cases the reduction in cost may be the most important property gained by their use.

A. Amberg. The answer for pine products was contained for the most part in my general comments. One or more of the pine products may be used in practically all kinds of rubber compounds. Probably the most distinctive properties common to all the pine products are that they give increased building tack and help to disperse pigments.

A. Powers. The coal-tar and polymeric plasticizers should not be regarded as a single group, but should be broken down into aromatic and non-aromatic materials. The aromatic resins have the best compatibility and are adaptable with oil-resistant synthetic rubbers. In general, they improve the stiffness, the processing characteristics and cut resistance of compounds. Their only limiting factor is the increase in stiffness and brittle point. The non-aromatic materials are indicated where the softer compounds are desired.

A. Pollack. Ester plasticizers should be considered to include at least two distinctly different types, the monomeric and the polymeric esters. The monomeric type, as you know, is commonly used for improvement of low-temperature performance. These esters are generally compatible with most of the rubbers on the market, but are mainly used with the oil-resistant types of rubber. This situation exists because the other plasticizers available to the oil-resistant rubbers are mainly aromatic products derived from natural sources, and they give very poor low-temperature properties.

I think ester plasticizers should be considered for use wherever price is not a limiting factor and the best possible low-temperature performance and resilience are desired. If, for example, you are using low-viscosity hydrocarbon oils as low-temperature softeners, you invariably have high volatility and losses from the stock. By proper selection of esters, you can not only have your cake, but eat it as you can get softeners that are not only better for low-temperature performance, but also much less volatile and therefore more permanent.

The other class of esters, the polymerics, are all of much higher viscosity and therefore do not compare with the monomeric esters for low-temperature work. The polymerics, however, are probably best of all available softeners when it comes to resistance to extraction by fuels, oils, or other media.

Q. Discuss the possibility of a low-temperature plasticizer (–70° F.) that will resist extraction in fuels and oils.

A. Pollack. In every business there are easy jobs and there are tough ones. This is not one of the easy jobs. Probably more research money has been spent on this problem than on any other single plasticizer problem. I don't know of any plasticizer which will do this job at present. I am happy to summarize what I know, however, about the attempts to make such a plasticizer.

Much of the work has had to do with trying to make a monomeric plasticizer of low viscosity which will not be soluble in fuels and oils while it will still be highly compatible with the rubber. In this work, researchers have been guided by the fact that changes in chemical structure can make big differences in solubility, compatibility, and low-temperature performance. To get plasticizers of greatly different structures from the fuel and oil hydrocarbons, they have tried to include as much oxygen, nitrogen, sulfur, and other non-hydrocarbon groups as possible. In this way a number of plasticizers have been made which were indeed insoluble in fuels and oils. They failed in actual service tests, however, for one or more of the following reasons: they were not compatible; they did not give good enough low-temperature performance; or they were still extracted in spite of their being insoluble in the extractant. This last effect is probably explained on the basis that the extractant is taken up by the rubber to some extent. Since the plasticizer is insoluble in the extractant, it is then thrown out of its solution in the rubber.

Another approach has been to improve the low-temperature properties of polymeric plasticizers which are not extractable. Here again the work has to do with the intimate details of the chemical structure. We know that if we can get high enough molecular weight, we can get non-extractability. High molecular weight generally goes with high viscosity and consequently poor low-temperature properties. The problem then becomes—how can we get a combination of high molecular weight and low viscosity all in the same molecule?

We do know, however, that chemical structure makes a tremendous difference in the viscosity of polymers. For example, we might have on the one hand a hard aromatic resin with a molecular weight of less than 1,000 which has a very high viscosity; while, on the other hand, we have a polyester made from sebacic acid and a glycol with a molecular weight of 7,000, but with a much lower viscosity than the aromatic resin. Such a polyester would be vastly superior from the point of view of combining low-temperature properties with non-extractability. The trouble is that no one has been able to build a polyester or related type of plasticizers which approaches –70° F. performance.

As I said before, it's a tough problem, but we do know something about the requirements, and it's entirely possible that someone will come up with a good answer before too long.

Q. What plasticizers are available that will resist oven temperatures to 250° F., low temperature of –40° F., and are not extracted by petroleum solvents?

A. Pollack. For complete resistance to extraction and excellent heat service, I would suggest the polymeric ester plasticizers. To achieve –40° F., the medium acrylonitrile content rubbers should be used with them.

Q. In laboratory abrasion measurements, softeners, particularly in large amounts, lubricate the abrasive and give reduced abrasion loss. To what extent do high softener levels contribute to resistance to tread wear of tires on the road by "lubricating" the road?

A. Juve. This question is suggesting that perhaps the good abrasion resistance of oil-extended treads is really an illusion. I think that this is unlikely for the reason that, with minor exceptions, the road surfaces can be considered as a continuous, clean abrasive surface. That this is probably the case is indicated by the fact that on abrasion testers in which a dust is used to prevent gumming of the abrasive, a high oil-containing stock behaves normally.

[14]Sun Oil Co., Philadelphia.

One of the exceptions to the concept of the road surface as a continuous, clean abrasive surface is the accumulation of gunk on the surface of concrete highways which does reduce the abrasiveness of the road surface. The source of the gunk, however, is not the tire being run at a particular time, but grease and crank-case oil and perhaps oils from tires previously run over the same track.

Q. What is the significance of the cloud point of coal-tar resins and its effect on rubber compounds?

A. Powers. The cloud point of coal-tar resins is the temperature at which a 70% of solution of the resin in white oil clouds. The higher the cloud point the poorer the solubility of the resin in rubber, and above 100° C. cloud point there may be difficulties in dispersing the resin.

The cloud point of the resin indicates its behavior in natural or synthetic rubber compounds. As the cloud point increases, the hardness and modulus increase markedly while ultimate tensile decreases slightly. This is true of natural, styrene-butadiene, and nitrile type synthetic rubber compounds. The table shows the results with a styrene-butadiene compound. The effect continues below the 40° values shown as limit here.

SBR Compound—Cloud Point *vs.* Physical Properties

Cloud Point ° C.	Hardness Shore A	Tensile, Psi.	M_{300} Psi.
40	50	3000	950
120	72	2800	1300

These results show that, with aromatic materials, large variations in behavior are possible. Also, it should be noted that the resins were of approximately the same softening point.

Q. In softeners what is the chemical nature of acidifins? Of the nitrogen bases?

A. Kurtz. The sum of nitrogen bases and the first and second acidifins is about the same as the total aromatics as determined by silica gel separation. The silica gel separation is a lot easier to run, and results are more reproducible.

The fraction called nitrogen bases in the Rostler analysis does contain the complex molecules which contain one or more atoms of nitrogen in acid reactive structures. The so-called nitrogen bases in many oils also include reactive aromatics which are not nitrogen bases.

Q. What are the relative merits of the Rostler[13] and the Sun Oil[2-5] methods of analysis of petroleum softeners?

A. Kurtz. The method of analysis published by Kurtz and Martin[2] gives rather complete information. The % aromatics and % saturates are obtained by silica gel separation. These fractions are further analyzed so that when everything is summed up, we have the % carbons in aromatic rings, the % carbons in naphthenic rings, and the % carbons in paraffinic rings.

Many of the properties of oils are related to the composition as expressed on this basis.

As discussed at the Minneapolis ACS meeting last fall and at the Cleveland Rubber Division[3] meeting this spring, a very fast analysis for % C_A, % C_N, and % C_P can be made if viscosity, gravity, and refractive index are known. Professor Waterman of Delft, Professor Edwin Smith of Ohio State University, and Shell Oil Co. have also presented methods for % C_A, % C_N, and % C_P based on physical property correlations.

This is not just a Sun Oil Co. point of view. It is an oil industry and university point of view.

The analysis by % C_A, % C_N, and % C_P is related to viscosity-gravity constant. Viscosity is related to molecular weight. This is about all the information you need for dealing with softener oils for styrene-butadiene polymers. Viscosity, gravity, and refractive index are the basic data needed.

A color measurement or the determination of % extractable with 85% acid (Rostler so-called nitrogen base test) can be used as an additional indication of the probable amount of chemically reactive material present.

For oil resistant rubber such as high Mooney viscosity Neoprene Type WHV, we also need to know how much saturated material is present since this will "bleed out" or "sweat out" first. A silica gel separation is the quickest and easiest way to get this. The % saturates can also be obtained as the unreacted residue after the Rostler method's three acid treatments. It is a harder way to get the information, however.

The Rostler method, when it was originally proposed, was a worthwhile though empirical approach to the composition of extender oils. It has served its purpose.

Q. What is a satisfactory softener for Neoprene Type 571 latex that is more or less ultra-violet light resistant?

A. Powers. Picco Emulsion No. 12[8] should be a satisfactory softener for Type 571 Neoprene latex, and this material has good ultra-violet stability.

Q. What are prospects for lower-cost plasticizers for low-temperature tire service?

A. Pollack. Looking at this as a future possibility, I think that the prospects for lower-cost plasticizers are reasonably good. Two trends point that way. First of these is the continuing price reductions as the industry builds up and volume grows. Secondly, much development work is in progress on creating new products and learning more about how to use the old ones. These are both avenues by which the rubber industry stands to benefit.

Q. Name a good non-staining system or combination of softeners which may be used to tackify carcass compounds composed of SBR and natural rubber blends?

A. Kurtz. For the oil portion of this system the aromatic-type oils are ruled out because of their staining tendencies particularly where white sidewalls are involved. This deletion leaves a choice between naphthenic and relatively paraffinic oils. Circosol 2XH, our naphthenic oil, has been widely used for this purpose, with entirely satisfactory results. It will incorporate in the rubber faster than the relatively paraffinic types.

If SBR rubber is blended with natural rubber, tack can be obtained by giving the natural rubber a little extra breakdown.

Staybilite[6] resin, a rosin derivative, aids tack.

For extreme resistance to staining, where processing is no problem, a paraffinic oil is recommended (V.G.C., .810 to .820). Process Oil 551 and Sun Process Oil 515[14] are examples.

A. Amberg. I would not hesitate to recommend the use of a stabilized rosin, either alone or in combination with other types of softeners, in mixed natural and synthetic rubber.

Q. Would like panel's recommendation for a tread splicing cement for treads made from oil-extended cold rubber (e.g., SBR 1712) and high black loadings.

A. Kurtz. A cement made from a natural rubber tread compound cut back with a solvent to give a suitable consistency is recommended. To get good tack, a little extra milling will help, but too much milling will give a weak cement.

We understand that one or two companies have made some use of synthetic rubber cements for tires.

In regard to the oil used, paraffinic oils will reduce tack and thus would have an adverse effect on splice performance; naphthenic oils or aromatic oils are satisfactory.

ASTM Radiation Group

A subcommittee to study the effects of nuclear and high energy radiation on the properties of plastics and electrical insulation has been formed by the American Society for Testing Materials, Phiadelphia, Pa. D. S. Ballantine, Brookhaven National Laboratory, has been named chairman.

The prime objective of the subcommittee, according to Mr. Ballantine, is to establish, where possible, standard methods of irradiation and standard methods for determining the effects of radiation on the physical and chemical properties of plastics and electrical insulation.

Sections of the subcommittee have been established to work in the following areas: nomenclature and definitions; dosimetry; correlation of various sources of radiation; total dosage and dose-rate effects; and post-irradiation effects. Participants in the work of these sections are invited.

Instrumentation Confab

The twelfth annual symposium on "Instrumentation for the Process Industries" will be held by the chemical engineering department of Agricultural & Mechanical College of Texas, College Station, Tex., January 23-25, 1957.

The series is designed to lead to an improved understanding of the principles and practice of instrumentation as applied to industrial plants operated by the continuous processing of fluids, such as petroleum refineries, natural gasoline and cycling plants, and a variety of chemical facilities.

Announcement of scheduled speakers and the subjects of their talks will be made at a later date.

Initial Southern Rubber Group Meeting Successful; New Group Plans Additional Two-Day Meetings

The initial meeting and organization of the new Southern Rubber Group, held in New Orleans, La., at the Jung Hotel, November 16 and 17, was remarkably successful and may be an indication of a bright future for this Group. An attendance of between 250 and 300 was noted for the two-day meeting, which began with an organizational meeting on the afternoon of the 16th and was followed by a social hour and banquet. The social hour was made possible by virtue of contributions from about 35 supplier companies.

In addition to the business of organizing the new Group, the afternoon meeting on November 16 was featured by a talk by B. S. Garvey, Jr., Sharples Chemicals Division, Pennsylvania Salt Mfg. Co., 1956 chairman, Rubber Division, American Chemical Society, on the subject of "The Division of Rubber Chemistry, The Rubber Groups, and a Southern Rubber Group."

The speaker for the evening dinner-meeting on November 16 was M. E. Lerner, editor, *Rubber Age*, who discussed "This Rubber Industry of Ours."

The program on the 17th consisted of two panel discussions, the first on "Compound Design," and the second entitled "Elastomers for Specific Applications."

The Business Meeting

The business meeting was opened by John M. Bolt, Naugatuck Chemical Division, United States Rubber Co., program chairman for the initial meeting.

Russell Grove, International Shoe Co., gave the invocation.

Harmon Connell, Armstrong Tire & Rubber Co., temporary chairman, then welcomed those present and reviewed the past history of the organization efforts of the Group. He stated that the meeting represented the results of almost two years effort by a number of people including the following: Mr. Bolt; T. R. Brown, The B. F. Goodrich Co.; J. R. Galloway, elastomers division, E. I. du Pont de Nemours & Co., Inc.; W. S. Hall, Phillips Chemical Co.; A. J. Hawkins and E. J. Strube, Du Pont; W. Horn and M. Mirsky, Guiberson Corp.; E. W. Kiel and M. H. Laatsch, Goodyear Tire & Rubber Co.; R. B. Pfau, C. P. Hall Co. of Illinois; R. W. Rice and E. H. Ruch, Firestone Tire & Rubber Co.; R. C. Whitmore, Better Monkey Grip Co.; and himself.

A survey of possible interest in the formation of a Southern Rubber Group had been conducted in which 126 rubber products manufacturing companies and 22 elastomer producers in the area to be served by the Group had been contacted. This area, incidentally, comprises the states of Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, and Texas. Replies favorable toward the formation of the new Group were received from 54 companies, and many verbal replies were also received. Suppliers to the industry were also contacted, and in almost every case they were also in favor of the new Group.

The objectives of the Group, as outlined in the proposed by-laws, were given as: (1) To provide a means of exchange of opinion and of disseminating technical information and experience of those concerned with rubber and closely allied industries. (2) To provide educational, recreational, and social facilities for members of the organization. (3) To present programs dealing with the technical aspects of all phases of the rubber industry. (4) To become affiliated with the Division of Rubber Chemistry, ACS.

Dr. Garvey explained the organization and objectives of the ACS and its divisions and local sections, with special reference to the Rubber Division and the local rubber groups. He pointed out that both the Rubber Division and the local groups engage in many activities that are supplementary and complementary and that by "sponsoring" the local groups, the Division furnishes a loose national organization of real value to the rubber and associated industries.

In connection with the Southern Rubber Group, he pointed out that most local rubber groups draw the majority of their members from a radius of 25 to 50 miles of a given city. The SRG territory covers 11 states and may present a problem in getting together for meetings. On the other hand, the relative isolation due to the distance between plants is an important reason for the Group to promote technical and social contacts. The synthetic rubber plants along the Gulf Coast produce a large percentage of American synthetic rubber, and the SRG should provide an opportunity for the men in these plants to discuss their product with the men in the rubber products manufacturing plants in the South, which they would not otherwise have. Meetings of the SRG may have to be continued on a two-day basis, however, in view of the distances the members may have to travel, Dr. Garvey further said.

Mr. Mirsky, by-laws committee chairman, next presented the proposed by-laws for the SRG, and these were approved with one minor modification.

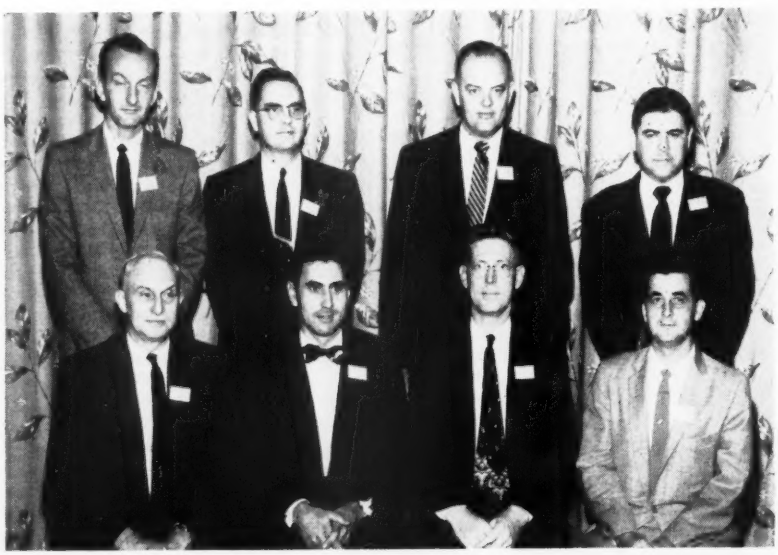
Mr. Kiel, chairman of the nominating committee, introduced the nominees for officers and directors of the Group, who were as follows: chairman, Mr. Connell; vice chairman, Mr. Brown, Martin E. Samuels, Copolymer Rubber & Chemical Corp., A. G. Susie, United Rubber & Chemical Co.; secretary, Mr. Hall, Paul W. Libby, J. M. Huber Corp., Mr. Pfau; treasurer, Robert L. Holmes, Raybestos-Manhattan, Inc.; Nyle B. Oswalt, Mohawk Rubber Co., Mr. Ruch.

Nominees for directors were, for two-year terms: W. J. Mohr, Southern Latex Corp.; Mr. Rice; Allan B. Craig, Witco Chemical Co.; and Mr. Galloway. Nominees for directors for one-year terms comprised: B. B. McMicken, Goodyear Synthetic Rubber Corp.; Mr. Mirsky; Mr. Bolt; and William F. Gerrow, Jr., Goodyear Chemical Division.

The Dinner-Meeting

At the dinner-meeting on the evening of November 16, G. H. Boeder, Goodrich, acted as master of ceremonies. After an invocation by Mr. Grove, the report of the election for officers and directors was presented by Mr. Kiel. The SRG officers and directors for 1956-57 will be as follows: chairman, Mr. Connell; vice chairman, Mr. Brown; secretary, Mr. Pfau; and treasurer, Mr. Ruch. Directors for the two-year term will be R. W. Rice and J. R. Galloway, and for the one-year term, M. Mirsky and J. M. Bolt.

In his talk, Mr. Lerner first emphasized that the rubber industry in the United States, which is presently consuming about 1,500,000 long tons of new rubber a year, can be expected to consume close to 2,750,000 long tons a year by 1975. He observed



Officers and directors of the new Southern Rubber Group, *left to right*, standing: J. R. Galloway, R. W. Rice, John M. Bolt, Monroe Mirsky, directors; *left to right*, seated: E. H. Ruch, treasurer; T. R. Brown, vice chairman; Harmon Connell, chairman, and Roger B. Pfau, secretary

M. E. Lerner addressing Southern Rubber Group at organization meeting

that the automobile industry will continue to use at least half of the additional rubber, with the remainder going to items of current use and to newer developments even now on the drawing boards.

Among the newer developments cited were "moving sidewalks" as well as conveyor-belt systems which will, in many instances, replace railroads in the transport of bulk materials; giant collapsible tanks made of rubberized fabrics for the storage of liquids; rubber treated fabrics for clothing; and increased use of rubber in the home in the form of wall coverings and for soundproofing.

In all these fields the rubber industry in the South will continue to play a major role. The 165 rubber goods plants in the South comprise almost 13% of the rubber plants in the country and employ about 13% of the persons actively engaged in the industry, it was said. These 165 plants consume about 125,000 long tons of rubber a year and account for the purchase of about $300,000,000 of the $2,225,000,000 expended by the entire industry for materials, services, and capital expenditures. The synthetic rubber producing plants in the South represent a capital investment of some $200,000,000.

The speaker declared that per capita consumption of rubber in the United States in 1956 would amount to about 20 pounds; while before the end of this century this figure will rise to 25 pounds a year. It is also expected that the per capita consumption of rubber in the rest of the world, presently far below that of the United States, will also rise substantially.

Panel Discussions

The first panel discussion, on "Compound Design," on the morning of November 16, was moderated by Mr. Laatsch. Members of the panel and their subjects were as follows: accelerators, R. W. McCullough, American Cyanamid Co.; antioxidants, R. H. Gerster, Monsanto Chemical Co.; equipment, L. H. Baker, General Tire & Rubber Co.; fillers, F. W. Wilcox, Witco; latex, K. M. Romick, J. G. Milligan Co.; plasticizers, J. E. Stonis, C. P. Hall; and reinforcing agents, R. A. Emmett, Columbian Carbon Co.

The afternoon panel-discussion program on "Elastomers for Specific Applications" had as its moderator Mr. Samuels. Members of this panel and their subjects were as follows: butyl, J. L. Ernst, Enjay Co., Inc.; Kel-F Elastomer, F. S. Honn, M. W. Kellogg Co.; natural and reclaimed rubber, E. H. Rothermel, Dayton Rubber Co.; neoprene and "Hypalon," L. R. Mayo, Du Pont; nitrile rubbers, W. J. Boyd, Xylos Rubber Co.; polymerization, F. J. Sackfield, American Synthetic Rubber Corp.; styrene-butadiene rubbers, J. F. Svetlik, Phillips Chemical; and silicone rubbers, T. D. Talcott, Dow Corning Corp.

Question-and-answer periods followed each of these symposia. The introductory talks and the questions and answers will be published in our January issue.

Mr. Connell, the Group chairman, closed the meeting by paying tribute to the program committee and the members of the panel who had worked so hard to make the meeting successful. He also thanked the supplier and rubber and rubber products manufacturing companies for their support.

The SRG has scheduled its next meeting for Dallas, Tex., February 15 and 16. Two panel discussion programs will be arranged for, and the subjects to be covered have been selected tentatively as "Processing" and "Reinforcement of Rubber Products with Textiles."

Chicago Hears Gonyer on Small Plant Automation

G. R. Gonyer, Chicago district manager of Farrel-Birmingham Co., Inc., Ansonia, Conn., discussed "Continuous Mixing in a Small Rubber Plant" before 200 members and guests of the Chicago Rubber Group at the Furniture Club, Chicago, Ill., November 2.

Mr. Gonyer described the installation of a high-horsepower Banbury mixer and slab extruder with handling equipment for continuous mixing in the Portland, Oreg., plant of W. J. Voit Co., producer of camelback, which estimated its requirements at 350,000 pounds of the retread rubber a month.

Aiming at an efficient and flexible installation, where labor costs are held to a minimum, Voit engineers decided upon a high-horsepower Banbury-extruder combination which would use a skilled operator capable of performing all operations manually. He would be stationed where he could see all the steps of the operation, with controls to permit any combination of operations from completely manual to almost completely automatic.

The basic pieces of equipment chosen were a size 3A high-horsepower Banbury mixer and a 12- by 8½-inch extruder with an externally supported cone-type head. A one-story building was erected to house these units separately.

The structure also contained automatic handling, weighing, and loading equipment for carbon black, mechanical delivery of rubber to the Banbury, preblending of dry powders, automatic oil injection into the Banbury, cooling conveyors, dip tank, slab cutter, and automatic stacking device.

After describing the design of a five-section control panel for the installation, Mr. Gonyer turned to the compounding techniques subsequently used at Voit. The rubber is cut, weighed, put on trays suspended from an overhead monorail, and delivered to the throat of the Banbury.

The carbon black and sawdust are contained in a large storage tank on the roof over the Banbury. They are delivered down through vertical tubes into a weigh hopper directly behind the floating weight cylinder on the Banbury. Both quantity and type of black and sawdust are controlled on the control panel by the operator.

The dry chemicals to be used are weighed out in quantities equal to 100 or 150 Banbury batches and loaded into a hopper. They are then passed through a crusher and dropped on to a conveyor belt for feeding into a large sigma-blade type of dry mixer. Following this operation, they are delivered mixed into paper bags in amounts equal to that required for one Banbury batch.

Six different process oils are used at Voit. A specially devised automatic oil-injection system, consisting of a metering cylinder, a pressure cylinder, and a differential transformer, is capable of handling up to 250 fluid ounces and delivering them in any combination of three oils into the same batch.

Three basic operations are performed in the Voit Banbury-extruder combination: crude rubber breakdown, masterbatching, and sulfurizing. This set-up means that all rubber compounds pass through the Banbury twice, and crude rubber three times.

The stock is extruded from the Banbury around an externally supported cone in tube form, is slit, and laid out in a sheet. The stock then goes up an inclined conveyor into the cooling conveyor and through a dip tank for coating with a non-sticking solution. Automatic cutting and stacking follow.

Concluding, Mr. Gonyer pointed out that the Voit installation can be adapted to many types of small plants if the necessary auxiliary equipment is used to augment the high-horsepower Banbury-extruder combination.

Rheology Society Awards

Arthur V. Tobolsky, Princeton University, was awarded the Bingham Medal of the Society of Rheology, November 8, during the organization's annual meeting at Mellon Institute, Pittsburgh, Pa., November 7-9. Professor Tobolsky was cited for his research in the elastoviscous properties of polymeric materials.

Technical papers read during the three-day meeting covered such subjects as adhesives and absorbed polymer layers, measurements of viscosity and normal stress, the effects of entrapped hydrogen on the mechanical properties of metals, and the theoretical aspects of the viscoelastic behavior exhibited by polymeric materials.

"Rubber-in-Engineering" Conference, NRDB September London Meeting Held

A special conference on the subject of "Rubber-in-Engineering" was organized by the Natural Rubber Development Board and held in London, England, September 27, with H. H. Facer, chairman of the Board, presiding at the opening of this meeting. More than 400 engineers and rubber technologists were in attendance at the conference.

The program consisted of five papers, excellent preprints of which were available before the meeting, and discussions of these papers, together with showings of the NRDB's new film on "Rubber-in-Engineering." The papers and the discussions which followed will be available from the Board, at no charge.

"Rubber Must Be Used Correctly," by W. J. S. Naunton, consultant and formerly of Imperial Chemical Industries, Ltd., was the first paper. In emphasizing the highlights of his paper, Dr. Naunton pointed out that for the engineer to obtain the best results from his use of rubber it must be correctly compounded, processed, and vulcanized for the purpose in hand, and it must be correctly designed for the unit in which it will function. The rubber product must also be correctly used during its service life.

In connection with rubber-to-metal bonded parts, it was suggested that such bonding was not always necessary or desirable, since bonding restricts the movement of the rubber component.

For all rubber parts exposed to sunlight or ozone, the use of 3% of antiozonants was recommended, and in the discussion which followed it was explained that some slight blooming of chemical antiozonants encouraged by the use of paraffin wax with these materials was beneficial.

Storage life of molded rubber products was said to approximate 20 years if the products were properly made and stored away from elevated temperatures and oil.

"Load-Deflection Relations and Surface Strain Distributions for Flat Rubber Pads," by A. N. Gent, of the British Rubber Producers Research Association, was the second paper. The author first explained that although the majority of rubber mountings and springs involves the use of rubber in compression, the problem of predicting the load-deformation relation in the simplest case—that of a cylindrical block with its flat surfaces bonded to rigid compressing plates—has proved most difficult even for small strains. Experimental measurements for this relation were described and were shown to be in fair agreement with a simple empirical relation for a wide range of thicknesses and for varied shaper of cross-section.

A. R. Payne, of the Research Association of British Rubber Manufacturers, in discussing Dr. Gent's paper, showed how the author's work agreeded closely with similar work done at the RABRM.

"The Use of Rubber in Heavy Engineering," by S. W. Marsh, Andre Rubber Co., Ltd., was the next paper on the program. The author first stated that his paper was designed to provide a general outline of the use of rubber in such applications as ships and jetties, general engineering (including buildings), couplings, and railway engineering.

In connection with the use of rubber in buildings, concern was expressed regarding the life and the retention of service characteristics, and Mr. Marsh explained that it was necessary to keep the stress and deflection characteristics within reasonable limits in order to obtain the desired service life. Permissible stress on rubber compression pads for buildings should be limited to about 250 to 300 psi., it was said.

"Dynamic Fatigue Life of Rubber Components," by P. W. Turner, Moulton Developments, Ltd., was the fourth paper on the program. In order to design with confidence rubber components for use under dynamic conditions, it is desirable to be able to fix the dimensions and other design parameters in such a way that the components will be as small, as light, and as cheap as possible on the one hand, and will have adequate reliability and fatigue life on the other hand, it was said. A program of fatigue testing was undertaken with about 200 test pieces, and an attempt was made to fit the results into a coherent pattern. It was gratifying to find that such a pattern existed, and by the use of simple curves it was possible to predict the fatigue life of components under given operating conditions, the author added.

If identical rubber components are tested under identical conditions, the scatter of fatigue life is such that there is little point, however, in attempting to predict fatigue life with an accuracy greater than one-third to three times a given value.

In response to a question on the fatigue life of styrene-butadiene synthetic rubber as compared with natural rubber, the author stated that the former had a fatigue life of one-tenth of that of the latter.

"Rubber in Agriculure," by S. J. Wright, agricultural adviser to Ford Motor Co., was the last paper of the conference. The author suggested the need of expansion of the use of rubber in agricultural machinery. Most farm machinery at present in use is about the same as it was 50 or more years ago, and the need of improvement is very great.

The use of the pneumatic tire on farm machinery was considered a worthwhile advance but it was stated that there was a real market for a track-laying tractor with a rubber jointed track.

New developments in farm machinery were illustrated by slides and included the following: (1) a section of rubber jointed track; (2) a loader with a wide rubber canvas belt; (3) a roller baler using rubber bands; (4) a potato sorter with rubber rollers.

W. B. Wiegand

Wiegand Colwyn Medalist

The council of the Institution of the Rubber Industry, London, England, has announced that the Institution's highest honor "awarded for conspicuous services of a scientific or technical character having an important bearing on the rubber industry," the Colwyn Medal for 1956, is to be given to W. B. Wiegand, director and research consultant for Columbian Carbon Co., New York, N. Y.

The Medal is being awarded to Mr. Wiegand in recognition of his outstanding work on carbon black spanning more than three decades. His developments were in the following fields: pigment reinforcement of rubber; dustless carbon black; modification of surface characteristics of carbon black particles; pH properties of colloidal carbons; electron microscope studies of carbons and their relations to rubber reinforcement; the chain structure of carbon particles and its control; development of furnace processes for producing carbon black and the improvement of the product; and the Joule effect and Carnot's cycle connected with rubber as demonstrated in the rubber pendulum and the rubber motor.

Presentation of the Medal will be made at a place and date to be announced.

Borden in Forest Research

A forest products research group has been established by the chemical division of Borden Co., New York, N. Y., for the development of resins and polymer products, particularly for new applications. George Kitazawa has been named head of the new group.

While pursuing projects designed to increase the company's manufacturing and marketing potential, the group will also consider requests from industry for specific research. Polymer and synthetic chemistry techniques will be employed in the research program, as well as such advanced methods as the use of radioactive tracers.

Boggs, Rieman Best Paper Atlantic City Meeting

The Best Paper Award for the September Atlantic City meeting of the Division of Rubber Chemistry of the American Chemical Society has been won by F. W. Boggs and W. P. Rieman, General Laboratories, United States Rubber Co., Passaic, N. J. The paper was entitled, "The Physics of the Friction of Rubber on Rough Surfaces."

This Award of the Rubber Division is based on not only the quality of the contents of the paper, but also on the excellence of its presentation and the quality of the slides or other illustrative material used. The actual award will be made to the authors at the next meeting of the Division in Montreal, P.Q., in May, 1957.

S. W. Boggs, group leader in synthetic rubber research, General Laboratories, U. S. Rubber, has been with the company since 1946. He has a Ph.D. in physical chemistry from Cornell University. He is a native of New Jersey although he has spent quite a bit of his life in Europe.

W. P. Rieman is a member of the same synthetic rubber research group as Dr. Boggs at the General Laboratories. Dr. Rieman started with U. S. Rubber in July, 1955. He obtained his Ph.D. in physical chemistry from the University of Wisconsin.

Di-Cup Talk at Buffalo

Walter S. Ropp, Hercules Powder Co., spoke on "Di-Cup—A Versatile Curing Agent," before 133 members and guests of the Buffalo Rubber Group at the Hotel Westbrook, Buffalo, N. Y., October 30.

The structure, preparation, and reactions of Di-Cup, Hercules' dicumyl peroxide, were discussed, and comparison was made to sulfur as a curing agent for rubber compounds. The speaker said the advantages of Di-Cup included whiter whites and the non-blowing characteristics of these compounds, while the disadvantages included the need of a constant cure time of 45 minutes at 300° F. The dicumyl peroxide was said to be finding wide acceptance in many fields.

The meeting was also addressed by Mr. Eathorne, United States Bureau of Mines, who discussed the history and nature of static electricity. A quantity of gasoline was detonated by static electricity as an example of the hazard this form of electrical energy is to industry.

PVC Bulk Polymerization

St. Gobain, Inc., New York, N. Y., is offering American and Canadian firms licenses to use a patented process for bulk polymerization of vinyl chloride developed by its French parent company, Saint-Gobain, Chauny & Cirey.

The process produces moldable and extrudable polyvinyl chloride. It has been in use in France since 1952 and was granted a United States patent in August, 1955.

Engineering Materials Talk Given at Southern Ohio

"What's New in Engineering Materials" was the subject of a talk given by H. R. Clauser, editor of *Materials and Methods*, before 67 members and guests of the Southern Ohio Rubber Group at the Dayton Engineer's Club, October 25.

In the plastics field, the ethylene polymers have enjoyed the most rapid growth as engineering materials, Mr. Clauser said. Led by polyethylene, they are soon expected to become the first billion-pound-a-year plastic. Irradiation of these polymers, coupled with low-pressure manufacturing techniques, has increased their heat resistance and high-temperature properties.

The polystyrenes and polyamides were also said to be increasing in popularity; the former because of the decrease in brittleness and increase in heat resistance brought about through the development of copolymers with butadiene and acrylonitrile; the latter because of developments of modifications possessing better moldability.

As for foams, the isocyanates, flexible vinyls, and rigid polystyrenes are also booming, the speaker declared. So is the use of plastic pipe and plastics reinforced with glass, asbestos, rayon, and nylon.

Moving next to the field of metals, Mr. Clauser discussed the high-manganese-low-nickel types, ultra-high strength steels, chromium - nickel - iron high - temperature steels, aluminum, magnesium, and titanium, among others.

In the ceramic field, he dealt with silica carbide, which is attracting attention as an engineering material because of its high thermal conductivity, good flexural strength, and good chemical resistance.

One of the most important coating developments in recent years has been the flame-spraying of oxide and carbide coatings. Such coatings have high-temperature resistance and compare favorably with stainless steel in respect to corrosion resistance. These coatings also have high hardness and low coefficient of thermal expansion.

Describing one of the newest lines of coating, which is based on butyl titanate, Mr. Clauser said these also have good high-temperature and corrosion resistance. They are, in addition, used to modify cellulose acetate butyrate to improve heat and solvent resistance.

The speaker was introduced by Harold J. Reindl, Inland Mfg. Division, General Motors Corp., chairman of the meeting.

Microscopy at Philadelphia

A talk on "Applications of the Microscope in the Rubber Industry" by Raymond P. Allen, a consultant in industrial microscopy, featured the October 26 meeting of the Philadelphia Rubber Group at the Poor Richard Club, Philadelphia, Pa. About 140 members and guests were in attendance.

Dr. Allen, currently doing consulting work for Harwick Standard Chemical Co. and The B. F. Goodrich Co., used projected colored microphotographs to prove the value of the microscope to the rubber industry. Such typical problems as surface blemishes, poor dispersion, foreign materials, and inexplicable failures were being solved in the laboratory through the use of the microscope, he declared.

The degree of magnification, use of ultraviolet light, and other techniques were said to play an important part in determining the causes of these problems by means of microscopic investigation.

B. S. Garvey, Sharples Chemicals Division, and chairman of the ACS Rubber Division, addressed the Group on the relation between the Rubber Division and an individual rubber group, during the short business session preceding Dr. Allen's talk.

R. A. Garrett, secretary-treasurer of the Group, reported that total membership now stands at a record high figure of 589.

The next meeting is scheduled for January 25 at the Poor Richard Club.

Philadelphia Group Dances

The Philadelphia Group held its annual fall dance at the Manufacturers Golf & Country Club, Oreland, Pa., November 16, with 130 members and guests in attendance. The evening's activities included dancing to the music of Dick Lilley's orchestra, awarding of 20 door prizes, and a free cocktail bar and midnight snack.

The committee in charge of arrangements consisted of T. W. Elkin, R. T. Vanderbilt Co., Inc.; R. B. Carroll, R. E. Carroll, Inc.; A. L. Shaw, The B. F. Goodrich Co.; A. J. DiMaggio, The Firestone Tire & Rubber Co.; T. J. Gorman, Quaker Rubber Co.; and R. A. Garrett, Armstrong Cork Co.

Connecticut Salesmen Fete

The Connecticut Rubber Group honored its salesmen at its fall meeting at the Actor's Colony Inn, Seymour, Conn., November 16. Andy Robustelli, defensive end of the New York Giants Pro Football Club, gave a talk on the life of a professional football player.

Chairman Jim Boyle, Armstrong Rubber Co., introduced Vice Chairman Harry Gordon, Bond Rubber Co., who will automatically become chairman for 1957. Mr. Boyle also announced the following slate of nominees for office:

R. T. Zimmerman, R. T. Vanderbilt Co., and W. J. Curtin, Naugatuck Chemical Division, for vice chairman; V. Chadwick, Armstrong Rubber Co., and D. G. Rowland, The B. F. Goodrich Co., for secretary; R. E. Sawyer, R. T. Vanderbilt, and W. Couch, Whitney Blake Co., for treasurer; and D. B. Doherty, Godfrey L. Cabot, Inc., G. R. Sprague, Goodrich, A. Merritt, The Goodyear Tire & Rubber Co., and D. Cummings, General Electric Co., for directors.

Quebec Petrochemical Talk

The Canadian petrochemicals industry was discussed by W. W. Stewart, manager of sales of the chemical products division

(Continued on page 460)

NEWS of the MONTH

Washington Report and National News Summary

. . . Implementation of the plan of the rubber products manufacturers to permit increased purchases of natural rubber from the strategic stockpile with the blocking of the Suez Canal was postponed just before Thanksgiving Day until the "emergency becomes more evident."

. . . Union Carbide & Carbon Corp. and Publicker Industries are both bidding for a long-term lease of the government's alcohol-butadiene plant at Louisville, Ky.

. . . Appraisal of government agency bids for the Synthetic Rubber Evaluation Laboratory at Akron, O., is to be completed by mid-January, and public bids asked after that date.

. . . The Federal Trade Commssion's attorneys have asked for a broadening of the scope of the complaint against three major rubber and three major oil companies regarding tires, batteries, and accessories sales commissions and selling.

. . . Commerce Department analysis of Census Bureau reports on rubber products industry highlights certain important changes in shipments and prices of various groups of products between the year 1947 and the year 1954.

. . . Comments from rubber industry executives indicate optimistic business outlook for 1956 and further growth in 1957.

Washington Report

By ROBERT E. L. ADAMSON

Plan To Use Stockpile Rubber To Ease Suez Shortages Postponed Until "Emergency Becomes More Evident"

Less than two weeks after it had turned thumbs-down on a rubber industry plan, for changing the natural rubber stockpile rotation procedure,[1] the government found itself taking another look at the need of special action to ease the possible shortage of natural rubber following the shutdown of the Suez Canal. At the end of a month-long whirl of rejections, reconsiderations, pleas, counter-pleas and reconsiderations, the government still could not make up its mind (by Thanksgiving) on the necessity of taking emergency steps.

GSA Industry Committee Split

Meanwhile the Rubber Industry Advisory Committee—18 strong—of the General Services Administration, the Government agency responsible for the administration of the natural rubber stockpile, split right down the middle on the propriety of government intervention short of an outright national emergency. The rubber goods manufacturers' team of advisors felt that a change in the rotation system of the government's stockpiled natural rubber was absolutely necessary to cut off sharp price increases as delayed arrivals of ships forced to go around South Africa tightened the United States' supply of natural rubber. The nine-man team of importer advisors sharply disagreed. In effect, they argued that the stockpile should not be used to influence the free rubber market except for an outright threat to the American military posture.

Decision to Flemming

At the time of this writing (November 26), the controversy had trickled upstairs to the man who has the last word on the multi-billion-dollar stockpile of rubber and other strategic materials—the head of the Office of Defense Mobilization, Arthur S. Flemming. As in all high-policy questions of this type, Dr. Flemming's guiding principles are two—national security and fairness to all. His tendency is to let time solve the controversy without government intervention. Above all, he demands full government consideration of all arguments and all facts to preclude premature interference and the possibility of damaging one segment of private industry to the advantage of another.

Thus, in late November, he had on his desk three letters of government policy relating to this matter: (1) to reject the proposal to modify the rotation system; (2) to approve the proposal in its original or an amended form; (3) to label the proposal as "too early."

History of Controversy

The controversy was born in September when The Rubber Manufacturers Association, Inc., sponsored the new rotation plan at a meeting of the Rubber Industry Advisory Committee of the GSA. The plan was divided into two parts, as follows: (1) Should the Suez Canal be blocked by war, the purchasers of rotation rubber would move to increase their purchases to offset delayed deliveries from the Far East. (2) Whether or not increased buying from the stockpile became necessary, GSA should be in a position to authorize a longer period of replacement. Buyers of rotation rubber agree to replace it with new rubber in 60 days under the present procedure; under the RMA plan they would have as long as 120 days to replace it.

[1] RUBBER WORLD, Nov., 1956, p. 279. (Note that the plan was accepted November 1 was premature. EDITOR.)

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GSA's rubber experts, Defense Materials boss, E. H. Weaver, and his Agriculture aid, George Casto, let the proposal ride for a month and then announced on October 22 that the easing of the Near East crisis during September and October had left the proposal moot. It was decided, however, to schedule another meeting with the Advisory group in January to reappraise the situation.

On October 30, Israel invaded Egypt, and Britain and France followed the next day. In the week of hostilities before a cease-fire, 19 ships were sunk in the Canal, effectively blocking it for months. Within 24 hours of the Israeli invasion, RMA president, Ross R. Ormsby, was on the phone to Dr. Flemming asking reconsideration of the RMA stockpile rotation proposal. Dr. Flemming agreed and asked Mr. Ormsby to put the plea in writing for consideration by his staff and the five-member inter-agency committee on rubber—GSA, ODM, and the Departments of State, Commerce, and Defense.

The RMA appeal found the stockpile situation on November 1 as follows: Of the 1.2-million-ton total, about 180,000 tons were available for rotation. Commercial buyers were taking about 7,500 tons per month, including 4,000 tons of below-grade rubber GSA was anxious to upgrade and 3,500 tons threatening to go bad. Under the law the government may not reduce the size of the stockpile without Congressional approval, but it may rotate up to 7,500 tons per month for upgrading and an unlimited amount of rubber facing deterioration.

In this situation RMA knew it would be hopeless to ask for outright disposal of some portion of the stockpile, but felt that a Suez-caused shortage could be dealt with effectively if the industry could get more time to replace increased purchases of rotation rubber. Increased purchases from the stockpile would be no solution, it was indicated, unless the government were willing to lengthen the 60-day replacement period. Even should the government accept the idea, RMA emphasized, it would not be activated unless or until a supply squeeze developed.

The RMA plan was not seriously objected to by either GSA or the importers group when it was proposed in September, probably because of the truce which developed after the first excitement of Egyptian seizure of Suez in July. When the plan was revived in October, however, the entire importer delegation on the GSA Rubber Industry Advisory Committee dispatched a dissenting telegram to Dr. Flemming. The ODM chief quickly called a meeting of both groups concerned, GSA officials and its Industry Advisory Committee, and the government's top inter-agency committee created to advise him directly.

The rubber importers group telegram protesting implementation of the RMA plan was signed by officials of Robert Badenhop Corp.; H. Muehlstein, Inc.; Jacobus F. Frank Co.; H. A. Astlett & Co.; Carl M. Loeb, Rhoades & Co.; Littlejohn & Co., Inc.; Avia Corp.; S. J. Pike Co.; and Imperial Commodities Corp., all members or alternate members of the GSA Industry Advisory Group.

The importers warned Dr. Flemming that no emergency existed to justify government intervention or a departure from the traditional policy against taking any stockpile action that might influence the free market.

"Natural rubber is being freely shipped from producing countries," the importers declared, "and ample supplies are available for sale" to satisfy the current demand. The importers group admitted that "some delays" in ship arrivals were inevitable, but contended that "the situation should correct itself."

With the advent of this opposition to the plan it soon became apparent that similar objections were being raised by members of Dr. Flemming's Inter-Agency Advisory Committee. On the eve of the GSA-industry meeting in early November, Everett G. Holt, assistant director for rubber, Business & Defense Service Administration, Commerce Department, issued an announcement designed to squelch talk of possible shortages. Mr. Holt said there would be a shift of rubber to vessels using the Panama Canal until Suez was reopened. Rubber already enroute to the United States via the traditional route, the announcement said, would assure normal arrivals for most of November, and any pinch which might develop in December would only be temporary.

"Europe is more affected rubberwise than the United States by the immediate situation," it was explained. "Stocks of natural rubber in Europe are not high, and substantial supplies for U. S. export are not available. . . ." (There will be an increased demand for U. S. synthetic rubber in European countries running short of natural.)

In the meantime, other members of the inter-agency committee indicated their agreement with the importers that stockpiled rubber should not be allowed to influence the market. One member pointed out that the early November price for No. 1 RSS was running 10¢ per pound below that of November, 1955, an indication to him that the market price was much too low to warrant government action.

Furthermore, the State Department has been consistently opposed to any U. S. move with stockpiled rubber which would upset our friendly relations with the rubber producing countries. The Department has emphasized repeatedly that our huge inventory was built up during emergency periods with the complete cooperation of these Far Eastern governments. In return, the U. S. promised that its reserves would never be used as a market control device which might reduce the revenues of free market sellers.

RMA Plan Postponed

Thus, in this atmosphere of argument and counter-argument, the inter-agency committee got together shortly after the manufacturers-importers showdown with GSA to vote adoption of a non-intervention policy by the government. The committee's unanimous recommendation, calling for postponement of the RMA plan until "an emergency becomes more evident," was presented to Dr. Flemming before Thanksgiving. At that point, implementation of the plan was given less than an even chance.

In any event, Dr. Flemming was certain to reject the idea barring clear-cut evidence that it was necessary for national defense.

Union Carbide, Publicker Still Want Louisville Alcohol-Butadiene Plant; Lease Disposal Planned

Two old adversaries hooked up in another duel in November over the future operation of the government-owned alcohol-butadiene plant at Louisville, Ky. Publicker Industries, of Philadelphia, and Union Carbide & Carbon Corp., New York, were the only bidders responding to a government offer to rent the plant under a long-term lease.

UCC Bid Rejected

UCC was the successful bidder over Publicker last spring when the plant was put up for sale by the defunct Rubber Producing Facilities Disposal Commission. Subsequently, however, Congress threw out the tentative sale contract on the advice of the Department of Justice that it would not promote a competitive synthetic rubber industry. The Justice Department opinion, as voiced by Attorney General Herbert Brownell, was based on the indication that UCC would have converted the plant to production of a product other than alcohol-butadiene, thereby taking it out of the competitive market for this commodity.

Heeding this advice, the House Armed Services Committee triggered a plan to sell the plant without the condition that it further competition and with the additional attraction that it need not be available for rubber production during the first 10 years of private ownership—the so-called national security contract found in most rubber plant sale contracts. The Armed Services Committee plan failed to get Congressional approval, however, and the idea of reoffering Louisville for sale under a less restrictive program was dropped.

Lease Approach Again

In lieu of sale the government decided to revive the idea of offering the plant for long-term lease, an idea contained in the original bill authorizing sale, but never utilized. Soon after the Federal Facilities Corp. took over responsibility for the plant from the Disposal Commission, FFC offered the plant for rent over a period of 5-15 years.

To the surprise of none, Publicker and UCC came back to the government by the November 1 deadline with offers to rent—the only firms to respond to the bid invitation. Details of the Publicker and the UCC offers were kept secret, pending negotiations between the companies and FFC aimed at bringing the government the best possible return.

This Louisville plant is now under lease to Publicker for a three-year term expiring April 4, 1958. Publicker has its own alcohol-producing facilities in Louisiana and stands in the best position to produce alco-

hol-butadiene profitably. Although only one of the plant's three production lines has been producing under Publicker operation, the facility has a promising future, tied in with the Goodrich-Gulf Chemicals, Inc., SBR synthetic rubber plant at Institute, W. Va. Institute has been regarded as a likely consumer of Louisville's butadiene when the former's modernization has been completed and it is ready to operate at full capacity.

On the other hand, UCC would probably convert the Louisville plant to production of another, more lucrative chemical. Unlike the original sale contract, a lease contract would not require that the plant promote a synthetic rubber industry, and UCC would be free to utilize the installation without regard to product, provided the plant were available for alcohol-butadiene production during a national emergency. Reconversion in an emergency, of course, would be done at the lessee's expense.

A lease to any firm but Publicker would be subject to the existing lease expiring in 1958. The plant is one of two alcohol-butadiene plants offered for sale by the government in 1954. The other, at Kobuta, Pa., was sold to Koppers Co., Inc., last year with the proviso that it be kept available for production until 1965. Although it is not in butadiene production, the power equipment is utilized for other purposes.

A long-term lease of the sister-plant at Louisville would be advantageous to both parties. Publicker has been agitating for a long-range commitment to protect the investment the set-up there merits under current and foreseeable market conditions, and this would be true of any company interested in the property. The government, on the other hand, would like to get out from under the cost of maintaining the two production lines now in standby and would like to boost the present $6 per ton paid by Publicker on each ton of butadiene produced by the third line.

RPFDC Prediction

In an indirect manner last spring's prediction on the future of Louisville, submitted to Congress by the Rubber Producing Facilities Disposal Commission, is now close to being realized. Before Congress cleared the way for sale of Louisville, the Commission said it believed "the possibility of a satisfactory sale to be highly remote. It is the Commission's opinion that a longer-term lease (than the one to Publicker) provides a more feasible solution." The Commission looked like a poor prophet during the late spring days when UCC's sale contract was approved by the Commission, but, at this date, long after the contract was overturned by Congress, the Commission seemed to have been right.

It might also be interesting, six months after the proposed sale was kayoed, to recall the Senate Banking Committee's comments on why long-term disposal to private industry has its merits: "There is a substantial shortage of butadiene. This has created a situation which makes it probable that these facilities could not be disposed of, either by sale or by long-term lease, under conditions which would be beneficial both to the producers and consumers of synthetic rubber and to the government and the taxpayer."

If FCC negotiates a long-term lease with Publicker or UCC by its December 15 deadline, it will submit the contract to the Justice Department for anti-trust clearance, then file it with Congress for review. Either House of Congress must reject the proposal, or it becomes valid 30 days after submission to Congress.

Government Lab Disposal; Agency vs. Public Bids

The General Services Administration was aiming last month to complete by mid-January the first phase of its complicated disposal procedure involving the Government Synthetic Rubber Laboratory at Akron, O. With all but one of 24 replies from other federal agencies in GSA hands by Thanksgiving, the government's disposal agent expected to have a completed appraisal abstract on federal interest in the Akron facility by January 15.

The 24 agencies were queried three months ago on the need of either the Akron laboratory facilities or the pilot plant, or both. If they had any need whatsoever, they were asked by GSA to come up with some idea on the dollar value. GSA officials said the closely guarded replies to this invitation ranged from no interest to "quite a bit"—the names of interested bidders and their dollar bids were quickly tabbed "confidential" by GSA, since a bid invitation to the public will be issued before the disposal program is complete, and GSA wanted none to have a tip-off on how high they would have to go to top the best government bid.

Public Bids January

With the disposal project gaining momentum after a slow start, GSA said it had decided to go ahead with its invitation to the public before completing its appraisal of the government bids. The agency had not quite decided, however, either to issue a call for auction-type offers or a call for sealed bids. The agency's normal practice is to advertise for either type of bid, but the latter, utilized by the Rubber Producing Facilities Disposal Commission, would leave GSA free to negotiate with the bidders for the highest possible return to the government.

By Christmas, or early January, GSA hopes to have placed a bid advertisement in a string of newspapers through its office in Chicago, the regional office closest to the facilities up for disposal. Should the round of responses from private interests fall short of what GSA calls the "fair market value," the agency would move into a round of talks with the bidders—together at first, then individually—to build up the bidding price.

Agency Bid Evaluation

At this point, the likelihood of ultimate disposal to the public hinges on the response to the 24-agency survey conducted during the first phase of the program. Though unwilling to discuss details of the bids, GSA spokesmen admitted that the Department of Agriculture, the only agency to have publicly expressed interest in Akron to date, had tendered the best bid for the facilities.

It was this Department, headed by controversial Ezra Taft Benson, which first suggested the unique disposal system which finds GSA offering the labs-pilot plant to the government, then withdrawing the offer long enough to find out if the taxpayers can come up with a better price. Agriculture could use the laboratories in its research effort to find new uses for farm products, but advised Congress before the Akron disposal bill was drawn up that it might be in the government's best interest to dispose of the entire facility and use the proceeds to build a lab exactly suited to the food research program.

Agency vs. Public Bids

In the end it appears that the disposal of Akron will take this route suggested by the Agriculture Department: i.e., the Department will put the highest government price tag on it, then sit back and hope that a private bidder will offer enough to finance specialized facilities for the farm laboratory.

In any event, the outcome rests not with GSA, but with the Bureau of the Budget, President Eisenhower's department of accounts. When the GSA appraisal of federal agency offers is ready, and the disposal agent has done its best to bring forth a realistic private offer, the Akron portfolio will be turned over to the Budget Bureau for the final decision on whether disposal is in the government's "best interests."

FTC Attorneys Ask Broader Scope TBA Sales Case

The Federal Trade Commission had before it in November a plea by its own attorneys which could lengthen considerably the three complaint cases against The B. F. Goodrich Co., Goodyear Tire & Rubber Co., Firestone Tire & Rubber Co., and three major oil companies which buy tires, batteries, and accessories from the rubber companies for marketing through their gasoline stations.

FTC attorneys in the case against Goodrich and The Texas Co. asked the Commission to let them bring Firestone and five other oil companies into the case, despite the fact that the Commission has a similar complaint against Firestone up for trial in a separate action. The plea by FTC's lawyers was for relief from a trial officer's ruling in the Goodrich-Texas case that (1) Firestone could be mentioned only to show that it deals with Texas for certain amounts of TBA items annually, and (2) the five oil companies, against which the Commission has filed no complaint, could not be brought into the case at all.

By mid-November, attorneys for Goodrich and Texas had moved to support the trial officer's ruling on the ground that their relations with companies not named in the complaint had no bearing on their relations with each other. Texas has a sales commission contract with Firestone—similar to that with Goodrich—and Goodrich sells TBA items to the five oil companies, Shell

American Petroleum Co., Continental Oil Co., Ohio Oil Co., Emblem Oil Co., and Jenney Mfg. Co. In a word, the Goodrich-Texas attorneys argued against the appeal this way: If the Commission wanted full information on the Goodrich-Texas activities with other TBA suppliers or purchasers, it would have named the other companies in the complaint.

Goodrich complained that it would have to shoulder an "intolerable" burden if called upon to defend its conduct with companies "whose complex operations are peculiarly within their knowledge." Its arrangements with the five oil companies not directly involved, Goodrich also pointed out, could not affect FTC's ultimate determination of the lawfulness of its arrangements with Texas.

The FTC lawyers who filed the appeal do not speak for the Commission itself, but, rather, are charged with developing all the facts the Commission might need in reaching its decision. In their appeal they said it was necessary to broaden the scope of the Goodrich-Texas complaint to provide a complete record of how these companies are allegedly "freezing-out" other firms from particular TBA markets. Goodrich and Texas, plus Firestone-Shell Oil Co. and Goodyear-Atlantic Refining Co. in separate complaints, have been accused of restraint of trade by virtue of sales-commission contracts calling for payment of a commission on TBA items sold through retail outlets of the oil companies.

Goodrich and Texas have fought the FTC attorneys down the line on the scope-of-the-hearings issue because their burden of proof would be enlarged considerably in their own case, and they might be dragged into the other cases if the Commission counsel have their way. Furthermore, Firestone, for example, would have to intervene in the Goodrich-Texas case to defend itself, then prove itself—all over again in the case where it is named as a respondent.

Meanwhile, all hearings on the complaints have been shelved until the Commission rules on the appeal.

Mexico To Improve Natural Rubber Output; Details on Guatemala Tire Company Plans

Mexico added its name in November to the growing list of Latin American Republics spurring domestic production of natural rubber and thereby reducing dependency on imports of both natural and synthetic for existing or planned manufacturing plants. According to information reaching here, the Mexican Government has decided to launch a "three-year plan" of tree planting to eliminate eventually the need of any imports. Imports for the current year are averaging about $32 million, including both natural and synthetic.

By 1959, Mexico hopes to have stabilized production in all four of its rubber growing areas by putting in new, high-yield trees and substituting these strains for some of those now producing at low levels. Eventually, Mexico thinks, its trees will produce enough rubber to complete the swing from an importing nation to an exporting one.

The country's program follows a similar decision by the Guatemalan Government to increase its natural output and raise the quality of its trees. The biggest difference between the two countries at this point is that Mexico has manufacturing facilities of its own; whereas Guatemala will not have its first production facility until about mid-1957.

Guatemala Tire Plant

Details of the Guatemalan factory, which became available here in November, show that it will go into production of more than 100,000 tires and tubes by mid-September of next year, unless the present schedule goes awry. It will be built under the joint aegis of The General Tire & Rubber Co. and Incatecu, S.A., "the largest rubber goods manufacturer in Central America." In October[1] the operation was described by sources here as a lone venture by Incatecu, but George Plihal, who will head the new joint firm, told RUBBER WORLD in a letter from Guatemala City that General Tire will hold a 7½% stock interest.

Under a unique aspect of the venture, Guatemala and its four Central America neighbors will have the opportunity to buy into the corporation and will consume the tire and tube output under a free-trade system. In addition, the new firm—now tabbed "Ginsa" by its founders—will receive special tax exemptions covering the first eight years of operation and freedom from import duties on all machinery, equipment, raw materials, and semi-manufactured products for the first 10 years of operation.

The plant's initial capacity will be 60,000 tires and 48,000 tubes annually, but Mr. Plihal said that addition of "comparatively little additional machinery" would boost production to 120,000 tires and 90,000 tubes a year. Ginsa's first unit will leave the production line by July 3, 1957, at the earliest, and September 15, 1957, at the latest.

American Financing

The company was organized last March by Mr. Plihal and a group of Guatemalan businessmen-industrialists. When General Tire was brought in later, W. O'Neil, the company's president and board chairman, was named to the Ginsa board of directors. Of the original $1,000,000 capitalization, the Guatemalan faction put up 40%, and a matching amount was reserved for subscription by interests in Salvador, Honduras, Nicaragua, and Costa Rica, or these governments, at $100,000 each. Though General Tire's stock participation is only 7½% now, Mr. Plihal disclosed, the company has an option on an additional 15,000 shares.

Another 10,000 shares are reserved for the American Overseas Finance Corp., New York, N. Y., which has offered Ginsa a $1,000,000, five-year loan to double its capitalization for the purchase of additional equipment in the United States. Should Ginsa turn down the loan offer, it will probably float a $1,000,000 bond issue.

Export 25% Output

Mr. Plihal estimated that the Guatemalan tire and tube market would consume up to 75% of the plant's initial output. The balance, he said, will be shipped to the other Central American countries duty-free in the cases of Costa Rica and Honduras and for 50% duty reductions in the case of El Salvador. A free-trade agreement with the fourth country, Nicaragua, is still under negotiation.

The plant, designed by General Tire engineers, will go up on a plot just outside Guatemala City beginning this month. All machinery will be supplied by a British firm and will begin arriving simultaneously with the start on construction.

[1]RUBBER WORLD, Nov., 1956, p. 281.

National News

Commerce Compares 1954 and 1947 Rubber Products Shipments; Census Reports Show Notable Changes

The Commerce Department's publication, "Chemical and Rubber—Industry Report," for October, 1956, includes an analysis of rubber products shipments in 1954 compared with those of 1947 which points up certain important changes. This analysis is based on recent advance reports of the Census of Manufactures.[1]

Analysis showed that the quantity of shipments of both tires and footwear was lower in 1954 than in 1947, with the higher 1954 values resulting from advances in wholesale prices, it was said. In "other rubber products" as a whole, there was a large increase in volume of business, with total shipment values in 1953 and 1954 exceeding the value of trade in tires and tubes, as shown in Table 1.

[1]RUBBER WORLD, Apr., 1956, p. 98; May, 1956, p. 261; Oct., 1956, p. 100.

TABLE I. ANNUAL VALUE OF MANUFACTURERS' RUBBER GOODS SHIPMENTS BY TYPE, FOR SELECTED YEARS, 1947-54

(Thousands of Dollars)

Year	Tires and Tubes	Footwear	Other Goods	Total
1954	1,621,917	163,275	1,743,519	3,528,711
1953	1,819,556	185,989	1,852,170	3,857,615
1952	1,782,132	196,399	1,737,097	3,715,628
1951	1,876,307	206,209	1,761,997	3,844,513
1950	1,602,269	137,418	1,397,139	3,136,826
1947	1,463,357	159,190	985,744	2,608,291

In connection with Table 1, it should be mentioned that the Commerce Department publication points out that while the 1954 data are the first fully reported annual statistics since 1947, the Bureau of the Census has made annual estimates based on sample reports from 1950 through 1953. According to these estimates, the total value of manufacturers' shipments of rubber goods in '54 was the lowest since '50.

Growth Items

Items in the "other rubber products" category which have shown the largest growth revealed latex foam products, tread rubber, rubber cement, molded goods, extrusion and lathe cut goods, rubber flooring and wall coverings, and rubber packing, identifiable as prominent groups which accounted for most of the increase.

Shipments of latex foam automobile seating increased from 14,637,000 pounds in 1947 to 51,747,000 in 1954; while the sales value per pound declined from 98¢ to 78¢. Foam upholstery volume rose from 3,950,000 pounds in 1947 to 53,512,000 in 1954, with value per pound dropping from $1.16 to 86¢. Mattress cores, reported at only 29,000 in 1947, advanced to 835,000 in 1954. Chemically blown sponge products, which increased from 41,988,000 pounds shipped in 1947 to 66,383,000 in 1954, also showed a decline in price per pound from 47.54¢ in '47 to 45.54 in 1954.

Since 1947, gains in demand for tread rubber have been registered every year, with sales of 310,951,000 pounds in 1954, compared with 96,284,000 in 1947; the price per pound increased slightly from 25.16¢ in 1947 to 26.86¢ in 1954.

Shipments of rubber cement rose to 136,868,000 gallons in 1954 from 17,650,000 in 1947, and the average price per gallon declined to 40¢, against $1.19 in 1947. The Commerce Department said that although the data for these two years might not be strictly comparable, it did indicate a tremendous growth in the consumption of rubber cements.

The quantity of molded goods shipped increased 75% to a level of 197,513,000 pounds in 1954; while the value per pound increased from 62.87¢ to 86.69¢.

Extruded and lathe cut goods increased in quantity 70% to 93,012,000 pounds; while the value per pound advanced 20.2% to 52.62¢ in 1954, from the 1947 figure.

Automotive mats, the largest item in the "rubber floor and wall coverings" group, accounted for 38,773,000 square yards, valued at $34,641,000, in 1954; matting in rolls amounted to 10,668,000 square yards, valued at $16,291,000; and wall coverings, to 9,336,000 square yards, valued at $5,232,000. The quantity of flooring rose from 5,178,000 square yards, valued at $14,314,000, in 1947 to 13,181,000 square yards, valued at $24,410,000, in 1954, with unit prices lower in the latter year.

Shipments of rubber packings for sealing moving parts of machinery amounted to 17,664,000 pounds in 1947 and 31,886,000 in 1954, when the value per pound was 89.31¢, an increase of 26.7% over the 1947 price.

Lower Shipment Items

In general, those rubber products which showed the greatest increases in unit value were also the ones showing reductions in quantity of shipments. The greatest increase in unit prices (per pound) was shown for garden hose, 76.3%; the price rose from 23.84¢ in 1947 to 42.03¢ in 1954. Shipments declined from 79,940,000 pounds in 1947 to only 21,918,000 in 1954, mostly because of the growing popularity of light plastic garden hoses, it was said.

The next greatest increase in price was for rubber heels, 64.6%; the reported value per dozen pairs rose from $1.17 in 1947 to $1.93 in 1954; while the quantity dropped from 317.6 million pairs to 235.7 million pairs. In this connection, there has been a 29% growth in trade in toplift sheets and soling slabs to 142 million square feet in 1954 at 6.7% lower prices per square foot. Since the 1954 volume of business in rubber soles was 24% greater than in 1947, it appears that the trade in toplift sheets has benefited mostly at the expense of the trade in heels, it was added.

Rubber beltings in general registered a decline in quantity of 1954 shipments. This was true of conveyor and elevator belting, flat transmission belting, and motor vehicle V-belts. Price increases were greatest for flat transmission and motor vehicle V-belts, 56.4% and 39.7%, respectively. A gain in volume of business was reported for industrial V-belts for which price increases averaged 10.7%.

Other principal items showing decline in quantity of trade accompanied by pronounced higher unit values include baby pants, water bottles, and pressure-sensitive tape, with average price increases ranging between 50 and 55%, and rubber tubing, with a 42.2% higher unit value.

Comparison Difficult

The Commerce Department analysis concluded with the statement that the seemingly loose relation between price and the volume of business has little significance because of the extensive changes from 1947 to 1954 in material used, in compounding, and in products and quality. Direct comparison of statistics for the two years, however, gives some idea of the magnitude of change and provides a new and more recent picture of the status of various segments of the rubber industry.

1956 Capital Expenditures Above Previous Estimate

Rubber products manufacturers expect to spend a record $109 million on new plant and equipment in the second half of 1956, a sharp increase over actual expenditures of $90 million in the first half of 1956 and $84 million in the second half of 1955, according to the U. S. Department of Commerce, Business & Defense Services Administration, in its "Chemical and Rubber—Industry Report," for October, 1956.

Total outlays for 1956 under this program would be $199 million, up 33% from the $150 million reached in 1955 and up 24% from the previous high of $161 million reached in 1953.

Capital investment in the first half of 1956 in total equaled the amount originally scheduled, although quarterly expenditures differed.[2]

Though the output of rubber products in this year is expected to be some 6% or 7% below the record 1955 level, the industry is preparing vigorously for increased future output, in view of these estimated expenditures for new plant and equipment.

Business Outlook, 1956-57

Optimistic comments on the business outlook for the last quarter of 1956 and the year 1957 are being made. In spite of the reduced activity of the third quarter of 1956, the rubber industry total business volume for 1956 may be unexpectedly gratifying.

Thomas Robins, Jr., president and chairman, Hewitt-Robins, Inc., said in mid-November that sales of that company's industrial products divisions, whose chief products are belt conveyor systems, and other material handling and power transmission machinery and industrial hose, were the highest of any nine-month period on record. The reduced demand for automotive cushioning and floor products adversely affected performance in these divisions for the first nine months.

He added that the outlook for the fourth quarter of 1956 was good not only for the industrial products divisions, but also for the foam rubber division. Backlogs of orders for conveyor equipment are approximately double those of a year ago, and increased foam rubber orders reflect improved conditions in the automotive industry.

The business outlook for the rubber products industry is bright for 1957, Karl O. Nygaard, economist for The B. F. Goodrich Co., said in a talk in Akron, O., recently. The gross national product, which merely adds up the value of all production in the nation, is expected to reach $430 billion in 1957, as against $411 billion this year, which is an increase of 4½%, he said. All indicators point to a sharper business increase in the first half of the year than in the second, he added.

Mr. Nygaard based his optimistic viewpoint on the outlook for a $9½-billion increase in consumer spending next year, a

[2] *Ibid.*, June, 1956, p. 429.

$3½-billion increase in business outlays for plant and equipment, and a $4-billion increase in government spending.

Referring to the rubber industry, the Goodrich economist said that a 10% increase foreseen in automobile production next year, some rise in truck output, and a steady growth in the replacement tire market give the rubber products industry a bright outlook.

He pointed out, however, that consumer spending is the most baffling to predict because public buying whims are not predictable for many lines of durable goods. Styles, shapes, and colors of new products such as automobiles greatly affect purchase decisions, and these are not known until the goods are produced and viewed by the public. Then the buying urge either develops or noticeably subsides. Forecasting the sales prospects for non-durable goods and services is much easier and more reliable, Nygaard said.

As an aside to this brief summary of recent comments on general business conditions, The Goodyear Tire & Rubber Co. announced a forthcoming reduction in the price of premium nylon tires for replacement sales. These reductions will become effective before the end of the year and will vary as to types and sizes. Truck and passenger tires of nylon construction are included in the price revisions. Original equipment lines and prices are not affected.

Firestone Strike Over; Wages Not an Issue

The Firestone Tire & Rubber Co. and the United Rubber, Cork, Linoleum & Plastic Workers of America, AFL-CIO, began negotiations on a new working conditions contract in Canton, O., October 9. When the existing agreement expired on October 31, the union called a strike in all plants of Firestone involved in the negotiations, and about 21,000 Firestone workers left their jobs.

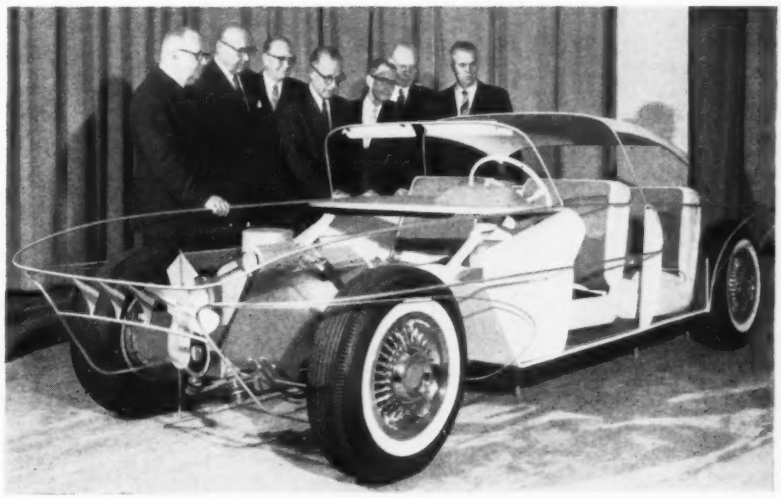
This strike ended on November 18, with agreement on a new contract which runs until April 15, 1959. Contract changes include further improvement in seniority provisions; clarification and improvement of wage and piece-work practices; a liberalized vacation program; and further protection for employe interests when outside contractors are engaged for work in Firestone plants.

The new contract provides an additional half-week vacation a year for employes with 11 to 14 years' service and for those with more than 25 years.

The agreement also provides for advance notification to the union when the company plans to hire outside contractors to do work in any of its plants. The union can then determine whether any of its own members might be able to do the work.

Provisions are also included for increased payments for lost time in the plant hospital in connection with injuries sustained in the factory; a maximum of three paid days off for a worker attending a funeral for a member of his immediate family; and, payment by the company of the difference between military pay and company pay when a worker is attending a summer training camp of the Armed Services.

Other Industry News



H. E. Humphreys, Jr., *center*, flanked by the company's six-man executive committee, studies the cutaway car exhibit at U. S. Rubber's newly opened permanent exhibit hall in Rockefeller Center, New York

U. S. Rubber Plans $40-Million Expansion in 1957; Permanent Exhibit Hall Opened as Product Showcase

United States Rubber Co., New York, N. Y., will invest about $40 million during 1957 in an expansion and modernization program that will bring capital expenditures by the company over a 10-year period to $260 million.

In making the announcement, H. E. Humphreys, Jr., president of U. S. Rubber, also predicted a record rubber industry sales volume of $6 billion in 1957 and an annual rate of $7 billion by 1960. He said 1956 rubber sales would be about $5.5 billion, about the same as in 1955.

Mr. Humphreys' statement was released at a press preview of the company's new permanent exhibit hall in Rockefeller Center, which was opened to the public on December 1. About two million people are expected to visit the hall during 1957.

Pointing out that the rubber industry is following a trend toward consumption of less material classified as rubber per dollar of sales, Mr. Humphreys said that United States rubber consumption during 1956 dropped 6% from the record 1,530,000 long tons consumed in 1955 to about 1,435,000 long tons this year.

He further declared that the industry was beginning to consume significant amounts of such newly discovered elastic materials as polyurethanes, polyvinyls, silicones, and polyisobutylenes, which the statistics do not classify as rubbers. That was partly why 1957 would see record-breaking sales, while rubber consumption would be below the '55 high, he said.

Mr. Humphreys predicted that American synthetic rubber exports would reach about 300,000 tons in 1957, compared with the 160,000 tons shipped in 1955 and the 250,000 tons shipped in 1956. Increased capacity for synthetic rubber production here will take care of the growing foreign demand, he added.

U. S. Rubber's new permanent exhibit hall was built to dramatize the wide diversification of the company's products in the fields of rubber, plastics, textiles, and chemicals.

One of the current features of the exhibition is an automobile with body sections removed to show the products made by the company for the automotive industry. These include a polyurethane crash pad, Naugahyde upholstery, Trilok fabric, and a seat which eliminates coil springs, combining a pneumatic foundation with foam rubber cushioning.

Also on view is a three-room home featuring new products of rubber, plastics, and textiles for architects and designers. The products were either made by the company or from raw materials it supplies. The living-room, bedroom, and dining areas were designed by *House Beautiful*.

Other exhibits include three giant spherical maps showing the company's worldwide operations, natural rubber growing and synthetic rubber manufacturing dioramas, a merchandising area, and live rubber trees from the company's Rutherford, N. J., experimental laboratories.

Seiberling Marks Birthday

The thirty-fifth anniversary of its founding was celebrated by The Seiberling Rubber Co., Akron, O., at the Masonic Temple, Barberton, O., November 15. The thirteen employes who have been with the company since its inception were honored at the ceremony. J. P. Seiberling, president, was the principal speaker.

About 250 persons attended the event marking the creation of the company by the late F. A. and C. W. Seiberling on November 16, 1921. The 13 original employes each received a 35-year plate and an extra week of vacation.

They were Alfred S. Bachtel, new products department; Lewis E. Baughman, pipefitter; Earl Bick, mechanical stores; Marcus L. Brown, president of Seiberling Rubber Co. of Canada, Ltd.; James Bryan, calender department; Elmer R. Gibson, purchasing manager.

Also A. R. Johnson, employe store manager; Clayton S. Jones, manager of cost accounting; Arthur A. Leedy, new products department; Cornelius McKiernon, electrician; Willard P. Seiberling, company secretary; Walter Sexton, curing department; and William Wagner, inspector.

Engineers' Role Outlined

Engineers and the nation's work force engaged in research, development, and related scientific fields hold the key to America's industrial and technological growth, Arthur Kelly, executive vice president, The B. F. Goodrich Co., Akron, O., told a meeting of engineering alumni of Michigan State University, at East Lansing, Mich., November 2.

He also said that increasing the standard of living of this country in the face of a decreasing labor market can come only if workers are freed from the necessity of performing strictly routine tasks, something the application of engineering skill can achieve.

Kelly also pointed out that scientists and engineers are currently being graduated at the rate of 186 out of each 1,000 students who earn first college degrees. To meet our basic needs of continued growth and expansion, 205 to 215 out of each 1,000 students should become scientists and engineers, he added.

Caprolan in Finer Deniers

Caprolan nylon filament yarns are now available for sampling purposes in a range of finer deniers from National Aniline Division, Allied Chemical & Dye Corp., New York, N. Y. The company has been producing Caprolan heavy yarns ranging from 2,000 to 50,000 denier for the past year.

Production has begun on bright 200 denier, 32 filament, ½-turn, Z-twist regular-tenacity Caprolan and 560 denier, 32 filament, 1-turn, Z-twist high-tenacity Caprolan yarns. Samples of bright 210 denier, 32 filament, 1-turn, Z-twist will also be made available in the near future.

ADL Expansion Under Way

Plans for expansion in Cambridge and Concord, Mass., have been announced by Arthur D. Little, Inc. Purchase of 170 acres in Concord and immediate new construction at Acorn Park in Cambridge are included in these plans, Earl P. Stevenson, board chairman, said.

The new construction at Cambridge will be a 40,000-square-foot building which will contain such activities as technical economics and operations research and will permit growth in other parts of the company, according to Mr. Stevenson. A 30,000-square-foot wing housing the company's flavor laboratory and its metallurgical engineering division was recently completed.

A 70,000-square-foot laboratory building for Nuclear Metals, Inc., a company affiliate, is expected to be built on the Concord tract. The firm is currently located in downtown Cambridge.

Elastomers Lab Honored

The elastomers laboratory of E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., has not had a lost-time injury since it was opened on July 1, 1929. The 27-year safety achievement is a record for the company.

Pierre S. du Pont, 3rd, secretary of the company and a member of its board, presented the laboratory staff with du Pont's Board of Directors' Safety Award on November 5. Speaking for management, he declared:

"The most precious assets of Du Pont are not our plants and laboratories, nor even our patents and processes, but our people. We can't afford to lose the services of any of our people through preventable injuries.

"People who work safely also work more efficiently, as a rule," he added.

Europe Seen Prosperous

Inflationary pressures are strong in Great Britain, Holland, and France, and high interest rates are being used to curtail credit in the interest of stabilizing the economies of these countries, John L. Collyer, board chairman of The B. F. Goodrich Co., Akron, O., said in November upon his return from a three-week business trip through Europe.

He said he was impressed with the high rate of business activity and full employment in these countries, where he visited the plants of Goodrich associate companies. The number of automobiles owned by industrial workers there was at a record high, he declared. The proposed free trade area of the "United States of Europe" will become a reality in the next few years, he predicted.

Commenting on the situation in the Middle East, he reiterated his opinion that the production of rubber goods in the United States and among the countries friendly to it would not be adversely affected by any interruption of shipping through the Suez Canal.

Jefferson Major Expansion

A major expansion of its petrochemicals plant at Port Neches, Tex., has been begun by Jefferson Chemical Co., jointly formed in 1944 by American Cyanamid Co. and The Texas Co.

In making the announcement, George R. Bryant, president, said the construction will increase production facilities for existing products, provide installations for the production of various raw materials now being purchased, and lead to the manufacture of several new products.

Ethylene production facilities will be tripled, those for ethylene glycol doubled, and those for ethylene oxide increased by 50%. A direct oxidation unit to produce ethylene oxide and a chlorine plant are included in the program.

Plans also call for a higher output of a number of other chemicals, including specialty amines such as morpholine, an emulsifier for rubless waxes and polishes, and ethylene oxide specialties. The new facilities will mark Jefferson's entry into the production of propylene oxide, propylene glycol, and other propylene derivatives, Mr. Bryant said.

Atomic Power Use Viewed

It is going to take 10 to 20 years before power produced by atomic reactors is competitive with power made from present fuels in most parts of the country, according to John W. Liska, assistant director of the chemical and physical research laboratories of The Firestone Tire & Rubber Co., Akron, O.

Dr. Liska made the observation upon his recent return from a year's study at the Oak Ridge School of Reactor Technology, Oak Ridge, Tenn. The school is sponsored by the Atomic Energy Commission and has as its purpose the training of engineers and scientists in the atomic energy field.

The Firestone physicist pointed out that the United States still has an adequate and relatively inexpensive supply of fossil fuels: namely coal and oil. He indicated that commercial atomic power may develop faster in countries where coal and oil are expensive, such as England.

Falls Engineering Lab

A laboratory and research center devoted to the problem of die cutting and splitting of rubber and synthetic materials has been opened by Falls Engineering & Machine Co., Cuyahoga Falls, O.

Test cutting for outside firms will be conducted on such stock as rubber, plastics, polyurethane, and polyvinyl chloride foams. Falls Engineering will submit written reports on these tests.

Among the machines already permanently installed in the laboratory are a heavy-duty roller die cutter with an automatic loading and unloading mechanism, and a leveling and splitting machine with automatic attachment. More equipment will be added later, including automatic splitters, it was said.

Carbide Petrochemical Unit at Full Production

The Pacific Coast's first petrochemicals plant producing ethylene oxide, ethylene glycol, and polyethylene—the Torrance, Calif., facilities of Carbide & Carbon Chemicals Co., New York, N. Y.—reached full-scale operations in early November, D. B. Benedict, president of the firm, revealed.

The company estimates that 1956 production of ethylene oxide in the United States will be about one billion pounds. Among its derivatives are plastics, synthetic fibers, detergents, and textile specialties. Almost half the ethylene oxide produced goes into the making of ethylene glycol, the base product of automotive all-winter anti-freeze.

Synthetic fiber manufacturers make use of ethylene oxide's readiness to combine with hydrogen cyanide. This is one step in the process for making acrylonitrile, from which several synthetic fibers are made, including Carbide's Dynel.

According to the company, polyethylene film is expected to remain the largest single market for polyethylene for some time to come, but non-packaging uses of film are expected to become increasingly important. Union Carbide produced the first commercial quantities of polyethylene in the United States in 1943 at its South Charleston, W. Va., plant.

The first use of this polyethylene was as insulation on wire and cable for wartime purposes. Polyethylene is currently being used to insulate the submarine telephone cables linking this country with Europe, Alaska, and Hawaii.

Conventional polyethylene and a new cellular polyethylene made by Bakelite Co., a division of Union Carbide, are said to be coming into favor for insulating domestic telephone lines. Close to 40 million pounds of polyethylene were used as insulation in 1955, and this year's total is expected to be higher.

Larger and heavier polyethylene products are under development, Bakelite says. A new technique for producing products is said to look promising in addition to the injection molding process currently used to make most housewares. Stiffer sheets of polyethylene with higher gloss are also becoming available.

Bakelite has been doing development work on methods to extrude a sheet of polyethylene and have it pass, while still hot, through forming equipment in much the same way that sheet metal is fed into stamping machines.

F-B Opens Milan Offices

Farrel-Birmingham Co., Inc., Ansonia, Conn., has established an office at Piazza della Republica 32, Milano, Italy, which will handle the sale of the company's products throughout Europe and the Near East.

Appointed manager of the new office is Sergio F. Tomassini, former director and works manager of S. A. Luigi Pomini, Italy, manufacturer of heavy machinery for the rubber, plastics, and other industries.

Mr. Tomassini received his doctor of engineering degree from the University of Rome in 1947. During World War II he served with the counter-intelligence services of the American and British armies.

He recently returned to Europe after a study of the company's operations at its Ansonia and Derby, Conn., plants, and those of the Buffalo, N. Y., gear division; the Rochester, N. Y., Consolidated Machine Tool Division; and the Roselle, N. J., Watson-Stillman Press Division.

Sergio F. Tomassini

Clevite Harris Expanding

Clevite Harris Products, Cleveland, O., will more than double the rubber compounding capacity of its Milan, O., plant, it was revealed by Matthew J. Fleming, Jr., president. The expansion is scheduled for completion next summer.

Key item in the expansion is a second Banbury mixer. The company, a unit of Clevite Corp., produces specially engineered rubber and rubber-and-metal parts for the automotive and other industries. The Milan facility is a rubber molding plant, with much of its production going to the firm's Napoleon, O., plant, where the parts are assembled.

Tour Resin Research

Advanced students at Rutgers University toured the facilities of Resin Research Laboratories, Newark, N. J., October 15, as illustration to their course in "Laboratory Techniques and Latest Developments in Coating Technology."

Company staff members Charles P. West, Howard Leiner, and Harvey Lieberman demonstrated recent development in instrumentation for laboratory and production, including a new electronic method for the measurement of corrosion resistance of organic coatings. Qualitative and quantitative testing of organic coatings were also discussed.

U.S.I. Assigned Patents

Three new patents relating to sodium and sodium products have been issued and assigned to U. S. Industrial Chemicals Co., division of National Distillers Products Corp., New York, N. Y.

United States patent No. 2,761,886, issued to Charles E. Frank and James S. Swinehart, describes a method of coupling styrene with alkyl aromatics using dispersed alkali metal, such as sodium.

U. S. patent No. 2,761,760, issued to Jonas Kamlet, covers a process for the manufacture of titanium tetrachloride by contacting a titania-containing material with nitrosyl chloride at a temperature of 400-1,300° C.

U. S. patent No. 2,761,882, issued to Robert E. Hulse and Stuart Schott, describes an improved continuous sodium reduction of fatty acid esters by sodium to give the corresponding fatty alcohols.

The company has announced plans for manufacturing titanium sponge by a sodium-based process. Other investigations of sodium as an intermediate in organic chemical synthesis are under way.

Maintenance Show Set

Sixty-two of the nation's experts in keeping American factories running will lead discussions at the eighth Plant Maintenance & Engineering Conference at Cleveland, O., January 28-31. The conference will be held in conjunction with a Plant Maintenance & Engineering Show.

Among the speakers will be Joseph B. Littler, Durez Plastics division, Hooker Electrochemical Co., who will talk during a session on "Maintenance in Continuous Operation Plants" under the chairmanship of Gordon M. Gallagher, Canadian Industries, Ltd.; and Richard T. Wise, The B. F. Goodrich Co., whose topic will be "Maintenance in Rubber Mills and Product Plants" in a session presided over by Maxwell S. Cole, Seiberling Rubber Co.

Theme of this year's meeting is "Good Maintenance or Bad—the Difference Is Profit."

Dewey & Almy Lab

Dewey & Almy Chemical Co., Cambridge, Mass., will build a new pilot laboratory to house equipment for the storage, distillation, and purification of monomers, as well as coagulation and drying facilities. It is expected to be completed by February, 1957, at a cost of $500,000.

The facilities will quadruple the area the company now has for pilot operations. Reactor equipment will range from quart size to 300-gallon capacity, both glass-lined and in stainless steel. Facilities will also be provided for research activity.

The new laboratory will be equipped for both emulsion and solvent polymerization. It will also have a high-temperature section for polyester, polyamide, and plasticizer research.

Dewey & Almy is a division of W. R. Grace & Co.

Amoco Will Build Plant

Amoco Chemicals Corp., Chicago, Ill., an affiliate of Standard Oil Co. (Indiana), will build a $10-million plant for the production of phthalic anhydride, isophthalic acid, terephthalic acid, dimethyl terephthalate, dimethyl isophthalate, and benzoic acid.

These are chemical intermediates used in the manufacture of dyestuffs, polymers for the synthetic fiber and film industry, alkyd resins for the paint industry, and in the manufacture of plasticizers.

The plant will be built at a still undetermined site in the Midwest. It will have a capacity of about 60 million pounds annually. A new hydrocarbon oxidation process, acquired exclusively by Standard Oil in 1955, will be employed. Completion of the plant is expected by 1958.

According to Standard Oil, the process permits the production of a diversified line of chemicals at a single plant from one source of raw material. The company tested the process for a year, developing "significant improvements."

Readies Lima Tire Plant

Lima Rubber Co., Lima, Peru, associated with The B. F. Goodrich Co., will begin production in its new tire plant in early 1957. Goodrich, while holding a minority interest in the Peruvian company, is supplying technical assistance.

Vincent Griffin, since 1946 associated with B. F. Goodrich, Ltd., has been named factory manager of the Lima plant. Also assigned were William H. Bice, as technical adviser on tire construction; and Robert J. Young, as technical adviser on tire compounding.

New Lord Mfg. Division

A special products division for the research, manufacturing, and marketing of adhesives, chemicals, and other polymers has been established by Lord Mfg. Co., Erie, Pa. The division will continue the company's efforts in this field.

As part of Lord's long-range research and development program, a grant to the Massachusetts Institute of Technology for study on the "Fundamentals of Adhesion" has been in effect for several years. Separate research and manufacturing facilities have been established at the firm's main plant.

G-E Raises Parts Cost

The prices of its fabricated silicone rubber parts have been increased 4-9% by the plastics department of General Electric Co., Decatur, Ill. Higher labor costs and operating expenses were given as reasons for the boost.

General molded goods were raised 4%; range gaskets 6%; and sheets and "super tough" parts 9%. G-E's plastics department has plants at Decatur and Taunton and Springfield, Mass.

New Jefferson Division

A sales research and development division has been created in the marketing department of Jefferson Chemical Co., New York, N. Y. A. K. May, associated with the company since 1947 in various technical service and sales capacities, has been named manager of the new division.

At the same time the company announced the establishment of an eastern sales region, with J. R. Carlson as manager; and a midwestern sales region, with R. E. Werley, Jr., as manager. Also appointed was Ben C. Hayton, to assistant to the general manager of the marketing department.

Texas-U. S. Research Unit

A 26-acre property in Parsippany-Troy Hills Township of Morristown, N. J., has been purchased by Texas-U. S. Chemical Co., New York, N. Y., for the construction of a research center. Work on the project will get under way next year.

United States Rubber Co., co-owner with The Texas Co. of Texas-U. S., is building a research center in Wayne Township, N. J., in the same general area of the acquired property.

The Texas-U. S. research center will be devoted to work on synthetic rubber and petrochemicals. Conversion of a house on the property to offices has already begun.

D & R Epoxy Resin Blocks

D & R Pilot Plants, Inc., Hazardville, Conn., is making available preformed blocks of epoxy resin in densities from five to 20 pounds per cubic foot and in sizes up to one by two by six feet. Trade named DuRafoam, the large resin blocks are said to be particularly useful in tool shops where they can be used for making check fixtures, templates, and models.

According to the company, the foam is fine textured, easily machined, dimensionally stable, and has compressive strengths of from 50 psi. at the lower densities to about 1,000 psi. at the higher densities. Since these blocks are thermoset, they can withstand high temperatures and active solvents.

French Honor L. H. Flett

Lawrence H. Flett, formerly director of new products and now consultant to National Aniline Division, Allied Chemical & Dye Corp., New York, N. Y., has been made an honorary member of Societe de Chimie Industrielle, France's leading society of chemists and chemical engineers.

The designation was bestowed at a banquet closing the twenty-ninth Congress of Industrial Chemistry in Paris, France, November 24. Mr. Flett, president of the American Section of the Societe, has been active in the affairs of the group in this country for many years. He retired from National Aniline in January, 1955, after 35 years of service with the company.

BFG Manila Plant Opens

Formal dedication of the new tire plant of Goodrich International Rubber Co. of Manila took place on October 26 with Philippine President Magsaysay and International B. F. Goodrich Co. president W. C. Gulick, among those in attendance. Philippine citizens hold the majority interest in this Goodrich associate company. B. F. Goodrich, with minority interest, is furnishing technical and production management.

The plant is located at Marikina, 12 miles from Manila. Built at a cost of $6,000,000, it will eventually employ about 600 people and will produce about 500 passenger, truck, and bus tires a day.

N. A. Tuason is president of the reorganized Goodrich International Rubber Co. of Manila, which for 28 years has been a subsidiary selling company for Goodrich products made in the United States. Lewis C. Hayden is executive vice president and general manager, and John R. Dietrich, formerly of Akron, is plant manager.

Naugatuck Names Geldard

Walter J. Geldard has been appointed marketing coordinator for Naugatuck Chemical division, United States Rubber Co., Naugatuck, Conn. He was formerly plastics sales manager for the division. In his new post he will advise all of the division's commodity groups on sales policies and merchandising methods.

Mr. Geldard joined Fisk Rubber Corp., which later became part of U. S. Rubber, in 1925. In 1941 he was transferred to Naugatuck, becoming rubber chemicals sales manager the following year, and plastics sales manager in 1953.

Offers Synthetic Paraffin

A South African synthetic paraffin said to be exceptionally hard and having a high melting point is being distributed exclusively in this country by Moore & Munger, New York, N. Y., under the trade name Paraflint.

The wax melts at 215° F., is water resistant, and has a high-shining quality when buffed, according to the company. It is said to be useful in the manufacture of rubber, plastics, insulation products, paints, and other goods. Paraflint is available in 50-pound bags.

National Lead Expansion

A new 25,000-ton-a-year expansion to its St. Louis, Mo., titanium pigment plant has been announced by National Lead Co., New York, N. Y. Completion of the new facilities is scheduled for mid-1958, according to Joseph A. Martino, president. The St. Louis plant was expanded recently by 36,000 tons a year.

The company is also constructing an 18,000-ton-a-year titanium pigment plant at Varennes, P.Q., Canada.

Monsanto Latex Binder For Paints Announced

Development of a new latex binder, which may be formulated into latex paints for a broad range of exterior and interior uses, has been announced by Monsanto Chemical Co., plastics division, Springfield, Mass.

Called Lytron 680, it is described as an interpolymer latex made from a combination of monomers. It is said to dry quickly, forming a tough, flexible film, strongly resistant to oxidation, and providing a durable coating, particularly suitable for exterior surfaces.

Even at near-freezing temperatures, Lytron 680 is capable of binding an unusually high volume of pigment into a tight, water-resistant film in a relatively short period, according to the company. It has good resistance to chalking and blistering and exhibits good adhesion to a variety of exterior and interior surfaces, including those marked by differential alkalinity.

Non-toxic and non-irritating to the skin, the latex may be formulated conveniently into paints which brush on easily. It is characterized by a mild, transient odor which dissipates quickly after application.

Developed primarily as a binder for exterior masonry paints, the latex was found effective in several other exterior and interior applications in company-conducted laboratory and field tests over the past two years.

Medium-Density Petrothene

National Petro-Chemical Corp., New York, N. Y., will be in commercial production of medium-density polyethylene before the end of the year, it was announced by Robert E. Hulse, vice president in charge of chemical activities for the parent company, National Distillers Products Corp.

The medium-density polyethylenes will be produced at the company's Tuscola, Ill., polyethylene plant and sold under the established trade mark, Petrothene, through the sales organization of U. S. Industrial Chemicals Co., division of National Distillers.

Total polyethylene production capacity at Tuscola will also be increased to 100 million pounds a year by mid-1957.

Wooster (Canada) Appoints

Shannon H. Hoover has been named vice president and general manager of the new $500,000 plant of Wooster Rubber Co. (Canada), Ltd., nearing completion at Cookeville, Ont. Wallace D. Sholdice has been appointed assistant secretary-assistant treasurer.

Other officers of the company, a subsidiary of The Wooster Rubber Co., Wooster, O., are James R. Caldwell, president; Forrest B. Shaw, vice president in charge of Canadian operations; James K. Buckwalter, vice president in charge of sales; and Donald E. Noble, vice president, secretary, and treasurer. All are officers of the parent company.

Seiberling 14-Inch Premium Passenger Tires

The complete line of premium passenger tires of The Seiberling Rubber Co., Akron, O., is being produced in the new 14-inch wheel sizes. Included are the Sealed-Aire, Safety, and Commuter tires, which will also continue to be made available in 15-inch and 16-inch sizes. The Sealed-Aire is a puncture-sealing tire with cell-like "bulkheads" which hold sealant gum in place. The Commuter is a winter tire with a tread intended to increase traction and reduce so-called snow-tire hum. The Safety tire is a vented high-speed tire with construction features said to be aimed at providing greater strength than standard models.

QM Raincoat Contracts

Two awards have been made by the Philadelphia Quartermaster Depot on invitation for bids QM-36-030-57-189 covering men's dismounted-type synthetic rubber raincoats for the U. S. Army. Irving Raincoat Co., New York, N. Y., has been granted a contract for 50,000 of the raincoats worth $289,500. Archer Rubber Co., Milford, Mass., has been contracted for 10,000 raincoats valued at $61,500.

Goodyear Garage Opens

A $300,000 garage for testing experimental tires has been put into operation by The Goodyear Tire & Rubber Co., Akron, O. The 18,750-square-foot facility will also be used to maintain the company's vehicles employed in its tire development program.

The garage will permit immediate, close-at-hand checks of all experimental tires and special projects in the development state, according to Walter Shively, Goodyear manager of tire engineering.

New Wilson Rubber Division

The Wilson Rubber Co., Canton, O., believed to be the world's largest exclusive manufacturer of rubber gloves since 1916, has organized an industrial division as part of its current expansion program.

E. Jack Barns has been named director of sales of the company, and T. L. Peterson, sales assistant to the executive vice president, in line with the program. Mr. Barns has been associated with the firm for more than 30 years. Mr. Peterson was formerly a division sales manager for Becton, Dickinson & Co., Rutherford, N. J., parent company of Wilson Rubber.

Adding Urethane Foam Lab

A technical service and research laboratory for urethane foams will be added to E. I. du Pont de Nemours & Co.'s recently completed elastomers laboratory at its Chestnut Run site, Wilmington, Del. Completion of the project is expected by later 1957.

The new wing will expand the company's customer service and investigate new uses for urethane foams. It will contain pilot-plant facilities, machinery, and other equipment for mixing and fabricating foams.

New Ripple Sole

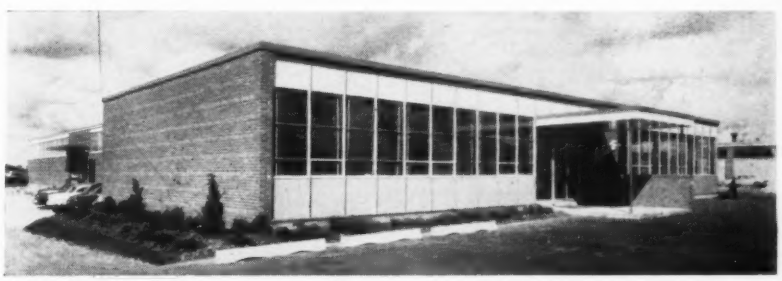
A new oil-resistant Ripple Sole will be shown for the first time at the forthcoming Chicago Shoe Fair by Ripple Sole Division of Beebe Rubber Co., Nashua, N. H., the company reveals.

The sole is said to be ideal for manufacturers who make work shoes for garage mechanics, station attendants, and others who work on oily floors. The sole is said to retain all the flexibility of the regular Ripple Sole, including its "rippling rhythm," which distributes weight, reduces walking shock, and provides greater traction.

Captive-Air U. S.-Wide

The Captive-Air safety tire, introduced by The Goodyear Tire & Rubber Co., Akron, O., in June, is now available to the consumer on a nationwide basis, it has been announced by Victor Holt, Jr., vice president in charge of tire sales.

The tire was test-marketed in the Charlotte, N. C., Cincinnati, O., Kansas City, Kan., Phoenix, Ariz., Portland, Oreg., and Detroit, Mich., areas. Success of these tests, together with the company's ability to expand production, prompted the nationwide move, Mr. Holt said.



KLEINERT IN CANADA: The recently opened plant and office building at Scarborough, Ont., Canada, of I. B. Kleinert Rubber Co., New York, N. Y., contains 30,000 square feet of floor space and has parking space for some 50 cars.

USC Retires H. L. Fisher

Harry L. Fisher, professor at the University of Southern California, and technical director of the Tlargi Foundation, jointly sponsored by The Los Angeles Rubber Group, Inc., and the University of Southern California, was retired by the University on August 31, 1956. The new director of the Tlargi Foundation is Edward Partridge, formerly of American Anode, Inc.[1]

Dr. Fisher, past president of the American Chemical Society, and a research worker and director of research, in some instances, for such companies as B. F. Goodrich, United States Rubber, and U. S. Industrial Chemicals, will begin a new chemical research position in January.

[1]RUBBER WORLD, Nov., 1956, p. 288.

New Monsanto Department

The research and engineering division of Monsanto Chemical Co., St. Louis, Mo., will establish a special laboratory to do research and development work on problems relating to national defense and national welfare which complement the company's own long-range projects.

In making the announcement Howard K. Nason, general manager of the division, said the new group will be known as the special projects department and will occupy the company's laboratory facilities at Everett, Mass.

Herbert E. Morris, associate director of research for Monsanto's plastic division, has been named director of the new department.

G-E Alkyd Unit to A-D-M

Archer-Daniels-Midland Co., Minneapolis, Minn., has bought the Schenectady, N. Y., alkyd resin business of General Electric Co., including finished goods inventories, equipment, formulations, and manufacturing specifications. The Schenectady plant was partially destroyed by an explosion and fire last March.

The operation of G-E's resin business at Anaheim, Calif., and the Toronto, Ont., business of Canadian General Electric Co., Ltd., are not affected by the transaction. The company's Anaheim plant will continue to use current identifying code numbers for its formulations of alkyd resins, trade named Glyptal, many of which have been independently developed at Anaheim.

Alkyd resins are used in protective coatings, compounds, and adhesives where resistance to heat, electrical arcing, humidity, acid, alkali, and oil is needed.

Resin Research Center

Resin Research Laboratories, Inc., Newark, N. J., has begun construction of a resin research center on the site now occupied by itself and its sister company, Polymer Engineering & Development Corp.

The center will consist of eight buildings, one of which will be equipped as a complete radiation laboratory. The other seven buildings will house laboratories for research and development in resins and polymers, paint and coatings, adhesives, insulation, corrosion, rubber, and fabrication, according to the company.

When completed, the new project will have pilot-plant equipment, including resin reactors of different types and auxiliary equipment. The new facilities will enable Polymer Engineering to undertake pilot-plant studies, process development, and design and construction of the plant.

Timken Investment/Employe

An investment of $12,264 in machinery, equipment, buildings, land, inventory, and working capital is needed to provide a job for every employe of The Timken Roller Bearing Co., Canton, O.

In revealing the figure, the company pointed out that on a nationwide basis the average investment per worker in manufacturing industries is $12,605. Since an estimated annual increase of one million workers is expected, it would take a yearly investment of $12,605,000,000 new money to keep employment at its present level, the company says.

Timken has invested for each of its 15,000 employes $6,081 in machinery and equipment; $1,332 in buildings; $201 in land; $669 in working capital; and $3,689 for inventory. Last year it reinvested $12,500,000 mostly for production machinery and equipment. The figure for 1956 is estimated at $12,000,000.

Correction

The maximum operating roll temperature of the inclined Z-calender designed by Farrel-Birmingham Co., Inc., for Bolta Division, General Tire & Rubber Co., as reported on page 287 of our November issue, was inadvertently said to be 500° C. The correct maximum operating roll temperature of the calender is 500° F.

Reginald H. Eagles

Obituaries

R. O. Shaw

R. O. Shaw, joint managing director of Francis Shaw & Co., Ltd., Manchester, England, died October 19 from injuries sustained in an automobile accident. He was 47.

Mr. Shaw served with H. W. Kearns & Co., Ltd., before joining Francis Shaw in 1928 as assistant works manager. He was appointed joint managing director in 1954 and founded a subsidiary company, Francis Shaw (Canada), Ltd., at Burlington, Ont., Canada.

He leaves a wife and two daughters.

MacNeel Pierce

MacNeel Pierce, founder and president of Plastic & Rubber Products Co., Los Angeles, Calif., died September 25 in Los Angeles of a coronary stroke.

Mr. Pierce joined Kirkhill Rubber Co. in 1931 and rose to the position of sales manager. He left to form Plastic & Rubber Products in 1941.

He held membership in The Los Angeles Rubber Group, Inc., the Jonathan Club, and Los Rancheros.

The deceased was born in Kilbourne, Wis., March 29, 1907.

He is survived by his wife, a daughter, a son, and his father.

Funeral services were held at the All Saints Episcopal Church, Beverly Hills, Calif., September 28. Burial was in Forest Lawn Memorial Park, Glendale, Calif.

Reginald H. Eagles

Reginald Harrison Eagles, vice president of the industrial products department, J. M. Huber Corp., New York, N. Y., died in his sleep while en route to Akron, O., on business, November 14.

He was born in Madison, N. J., June 9, 1895. Mr. Eagles was graduated from Cornell University and saw service in World War I. During World War II, he was a member of the Carbon Black Industry Advisory Committee of the War Production Board.

Mr. Eagles joined the Huber company in 1923 as a carbon black salesman and set up a network of agents with a sales program that resulted in the first of many expansions for the company. In a reorganization of the company in 1947, Huber's sales of carbon black, clay, and chemicals were merged to form the industrial products department, headed by Mr. Eagles.

Funeral services were held at Grace Church, Hastings-on-Hudson, N. Y., on November 16, followed by interment at Ferncliff Mausoleum.

He is survived by his wife, four children, six grandchildren, a brother, and a sister.

A. B. Matthews

A. B. Matthews, since 1948 employment manager for The Goodyear Tire & Rubber Co., Akron, O., died October 27 after a long illness.

Born in Fort Covington, N. Y., Mr. Matthews studied journalism at Purdue University, and the University of Illinois. He was a writer for the *Lafayette Courier* and the *Indianapolis Star* before joining Miller Rubber Co., Akron, in 1916. He became associated with Goodyear in 1918 as a labor interviewer.

Between 1926 and 1934, he was personnel manager of Goodyear's Cedartown, Ga., textile mill, and moved back to Akron as employment division manager in 1934. He became head of the labor division in 1937.

During World War II, the deceased developed a hiring program for Goodyear Aircraft Corp., whose total personnel at one time reached 30,000.

Surviving are his wife, two sons, a daughter, and two grandchildren.

V. R. Jacobs

V. R. Jacobs, since 1936 manager of government sales for The Goodyear Tire & Rubber Co., Akron, O., died October 20 at Akron General Hospital following an extended illness.

A leading authority on lighter-than-air craft and aeronautics, Mr. Jacobs was prominent in Goodyear's airship manufacturing activities. He lectured widely on the subject.

Mr. Jacobs was graduated from Albion College and served in the United States Navy during World War I. He joined Goodyear in 1920 in the tire sales department and was named assistant manager of government sales four years later. He was appointed assistant manager of government sales and aeronautics in 1932 and manager of the department in 1936.

He also served at one time as assistant sales manager of the former Goodyear Zeppelin Corp.

He was born in Grand Rapids, Mich., on September 8, 1896.

Mr. Jacobs is survived by his wife, two sons, and four grandchildren.

Funeral services were held at The Billows Co., Cuyahoga Falls Chapel, Akron, October 22. Burial was in Rose Hill Cemetery, Akron.

Leland H. Shepherd

Leland H. Shepherd, 66, since 1937 southern tire sales division manager of The Goodyear Tire & Rubber Co., Akron, O., died at Atlanta, Ga., November 22 after a protracted illness.

The deceased was graduated from Ohio Wesleyan University with a B.S. degree in 1912. He worked for Jones & Laughlin Steel Co. and two rubber firms before entering the U. S. Navy during World War I.

In 1926, he joined Goodyear in its western sales division office and served successively as assistant district manager at Detroit and at Kansas City, district manager at Charlotte and at Chicago, manager of the truck tire department at Akron, New York district manager, and manager of the southern division.

Mr. Shepherd is survived by his wife and a son.

Funeral services were held November 24 at the Spring Hill Funeral Home of Atlanta.

News Briefs

Columbian Carbon Co. has opened its new headquarters at 452 E. Market St., Akron, O.

Enjay Co., Inc., butyl division, New York, N. Y., has completed modifications in its Vistanex LM production facilities which have boosted output of the isobutylene polymer. A new booklet discussing Vistanex LM and its applications is available from the company.

Monsanto Chemical Co., St. Louis, Mo., will expand its Monsanto, Ill., phenol plant, boosting the company's output of the chemical by about 25%.

The Firestone Tire & Rubber Co., Akron, O., is building a new district office and warehouse at South Adams and Griswold Sts., Peoria, Ill. Completion of the two-story structure is expected by April 1.

Pennsylvania Salt Mfg. Co., Philadelphia, Pa., will acquire Delco Chemicals, Inc., Los Angeles, Calif., producer of organic and inorganic specialty cleaning and paint stripping compounds for the aircraft industry and for general maintenance purposes.

Easton Plastics Products Co., Inc., New York, N. Y., has expanded its rigid PVC pipe line to include all standard sizes from ¼-inch to six inches.

The Goodyear Tire & Rubber Co., Akron, O., has been awarded for the fifth year a bronze "Oscar of Industry" for the best submitted annual financial report in the rubber and tire industry. The weekly magazine, *Financial World*, has sponsored the award for the past 16 years.

B. F. Goodrich Co.'s Geon vinyl resin is being used to make lightweight, high-impact plastic pipe for a U. S. Navy anti-radioactive fallout washdown system. The equipment was developed by Grinnell Co., Providence, R. I., in conjunction with the Bureau of Ships.

Oronite Chemical Co., San Francisco, Calif., has divided its eastern sales region into a northeastern district, with headquarters in New York, N. Y., and a southeastern district, with offices in Wilmington, Del. E. J. Van Buskirk has been named manager of the northeastern district; while B. W. Colaianni has been appointed manager of the southeastern district.

Goodrich-Gulf Chemicals, Inc., Cleveland, O., has begun production of Ameripol SN, its synthetic polyisoprene rubber, at its new Avon Lake, O., pilot plant. The synthesized natural rubber will shortly be made available to other companies for testing purposes, according to Goodrich-Gulf.

Northrop Aircraft, Inc., is coating the electronic panels of its Snark guided missile and F-89 interceptor with Dow Corning Corp.'s Silastic RTV, a room temperature-curing silicone rubber that cushions vibration, provides moisture resistance, and improves surface resistivity of the electronic gear.

Minnesota Mining & Mfg. Co. has expanded by 50% its adhesives and coatings manufacturing facilities at Los Angeles, Calif., including a new research laboratory and additional production and warehouse space.

The B. F. Goodrich Co.'s Koroseal rigid polyvinyl chloride pipe has been used to carry 78% sulfuric acid in the superphosphate plant of Cotton Producers Association's plant food division, Carrollton, Ga., since July, 1955, without maintenance, Goodrich reports.

Dow Corning Corp., Midland, Mich., reveals that its Silastic S-9711 has been used to make an automatic brain valve to treat hydrocephalus, the so-called water on the brain. The device was invented by John Holter of Bridgeport, Pa., to save the life of his own son.

Dominion Rubber Co., Ltd., Montreal, P.Q., Canada, has begun operations at its new $2,500,000 foam rubber plant in Kitchener, Ont. The plant has 60,000 square feet of floor space and will employ about 100 people.

Wooster Rubber Co., Wooster, O., has sold $1,500,000 in promissory notes, due 1958-67, to Equitable Life Assurance Society of the United States. Wooster will use the proceeds to retire a bank loan and to build additional plant facilities.

Polymer Corp., Ltd., Sarnia, Ont., Canada, has donated $25,000 toward the cost of a nuclear reactor to be owned and operated by Hamilton College, McMaster University, Hamilton, Ont.

Thermoid Co., Trenton, N. J., through Ridbo Laboratories, Inc., a wholly-owned subsidiary, has acquired the molded flexible radiator hose division of W. J. Voit Rubber Corp. at Danville, Ill.

Johns-Manville Corp. will expand its Dutch Brand Division plant in Chicago, Ill., by about 50%, with completion of the project expected by early 1958.

B. F. Goodrich Rubber Co. of Canada, Ltd., Kitchener, Ont., expects to complete its $3,500,000 Welland, Ont., Geon resin plant in early 1957. Harold R. Pletch will be plant manager.

The Goodyear Tire & Rubber Co., Akron, O., is now producing its Captive-Air safety tire in 14-inch sizes, as well as in 15-inch.

The Firestone Tire & Rubber Co., Akron, O., has paid more than $1,000,000 to employes for suggestions to improve production. More than 60,000 of the 200,000 suggestions submitted since the system began in 1931 have been adopted.

U. S. Industrial Chemicals Co., New York, N. Y., has awarded first prize, a portable television set, in its polyethylene production estimate contest to Akira Kume, of Daiichi Bussan Kaisha, Ltd., New York.

Cellofilm Industries, Inc., Woodbridge, N. J., has named Baird Chemical Corp., New York, N. Y., sales representative for its nitrocellulose base solutions.

Quebec Talk

(*Continued from page 445*)

of Imperial Oil, Ltd., before 65 members and guests of the Quebec Rubber & Plastics Group at the Queens Hotel, Montreal, P.Q., Canada, October 18.

Dr. Stewart demonstrated the relation between the petrochemical industry and the rubber and plastics industries by listing various rubbers and plastics, the raw materials for which are supplied by the petrochemical industry.

He reviewed the history of petrochemicals in Canada, beginning with the construction of Polymer Corp.'s synthetic rubber plant in Sarnia in 1942. Declaring that 1960-1965 will be boom years for petrochemicals in Canada, the speaker pointed out that only 50 pounds of petroleum products per person are consumed annually, compared with 200 pounds per person in the United States.

A description of the manufacturing operations involved in petroleum processing, illustrated with slides, concluded Dr. Stewart's talk.

News About People

Walter D. Baldwin, director of manufacturers sales for the tire division of United States Rubber Co., New York, N. Y., has been appointed executive assistant to the division's vice president and general manager, G. R. Cuthbertson. **Herbert D. Smith,** manager of oil marketer sales, assumes Mr. Baldwin's former duties. **Thomas J. Newton,** product manager in the division, has been named director of private-brand sales.

Edwin L. Parker has joined A. G. Spalding & Bros., Inc., Chicopee, Mass., as executive vice president. A former professional tennis player, Mr. Parker has been associated with The Seiberling Rubber Co. and The Firestone Tire & Rubber Co., among others.

Paul P. Foley has been promoted to assistant general traffic manager of Godfrey L. Cabot, Inc., Boston, Mass.

L. L. Baseler has been appointed assistant director of marketing in the overseas division of Monsanto Chemical Co., St. Louis, Mo., and has been succeeded as the division's director of sales by **Kenneth R. Stelloh. Arthur M. Moore** succeeds Mr. Stelloh as New York district office manager.

R. K. Turner, a vice president of Bakelite Co., has been appointed a vice president of Carbide & Carbon Chemicals Co., New York, N. Y. He will be concerned with plastics operations of both companies, which are divisions of Union Carbide & Carbon Corp.

W. F. Billingsley has been named technical director of B. F. Goodrich Tire Co., Akron, O., succeeding **Harold Gray,** who is on a special assignment. Mr. Billingsley, formerly manager of tire construction and design, joined Goodrich in 1929.

W. L. Fawcett and **D. E. Setter** have been appointed sales service and development engineers in the plastics sales division of Phillips Chemical Co., Bartlesville, Okla. **P. J. Boeke** has been named manager of the sales service laboratory branch of the division and will have the assistance of group leaders **P. E. Campbell,** in evaluation; **Robert Doyle,** in extrusion; and **J. N. Scott,** in molding.

John V. Killheffer, Jr., has been appointed to the research staff of Emery Industries, Inc., Cincinnati, O., where he will be associated with the plasticizer group of the process research section.

Henry M. Haase has been elected vice president in charge of engineering and research for Borg-Warner Corp., Chicago, Ill.

George A. Harrington has been named general manager of development for Amoco Chemicals Corp., Chicago, Ill., and **Howard R. Peterson** has been appointed manager of special products in the newly formed company's marketing department. Dr. Harrington was formerly market research director for Indoil Chemical Co. Mr. Peterson was formerly manager of Indoil's sales department.

E. R. Current has been appointed staff manager for B. F. Goodrich Rubber Co. of Canada, Ltd., Kitchener, Ont. Also advanced were **Marshall W. Roth,** to manager of tire construction; and **R. A. Knowlton,** to production manager in the tire division.

John A. Riddell has joined the agricultural chemical research and development staff of Naugatuck Chemical Division, United States Rubber Co., as plant physiologist and will headquarter in the company's Bethany, Conn., agricultural experiment station.

J. M. Delorme has been appointed manager of manufacturers' sales for the tire division of Dominion Rubber Co., Ltd., Kitchener, Ont., Canada, replacing **J. D. Ferguson,** who was advanced to assistant sales manager.

William F. Wrightnour has been appointed operations manager for the tire division of United States Rubber Co., New York, N. Y. He will continue to coordinate the management development activities of the division.

Robert E. Haverman, assistant manager of the government sales department of The Goodyear Tire & Rubber Co., Akron, O., has been promoted to manager of the department. He succeeds **V. R. Jacobs,** who died recently.

Roger E. Caffier has been named chemical sales representative to Rhode Island and southern Massachusetts for Barrett Division, Allied Chemical & Dye Corp., New York, N. Y.

Frank A. Connell has joined the marketing department of Polymer Chemicals Division of W. R. Grace & Co., New York, N. Y., as technical representative for new linear polyolefin resins.

Nelson V. Seeger

Ernest L. Puskas

Robert W. Lea

Nelson V. Seeger has joined Diamond Alkali Co., Cleveland, O., as associate director of exploratory research. For the past 16 years he was associated with The Goodyear Tire & Rubber Co. as a research chemist. Dr. Seeger will be located at Diamond Alkali's Painesville, O., research center, where he will hold primary responsibility for the company's development and research activities in monomer, polymer, and radiation chemistry.

Miss Margaret Andel and **Mrs. Patricia H. Moyer** have joined the B. F. Goodrich Research Center, Brecksville, O., as an analytic secretary and member of the organic chemical technical staff, respectively. **William R. Bidwell** has joined the Center's staff as a mechanical engineer, and **B. A. DiLiddo** has joined as a technical man.

Orris H. Johnson has been advanced from assistant manager of tire design at The Seiberling Rubber Co., Akron, O., to manager. He succeeds **Louis Michelson,** who has resigned.

Donald J. Badamo has joined Dow Corning Corp., Midland, Mich., as a technical representative. He will be engaged in coordinating the sales and development efforts for the company's Silastic.

Alden R. Ludlow, Jr., since 1946 manager of alcohol sales for U. S. Industrial Chemicals Co., New York, N. Y., has been named director of sales, succeeding **Lee A. Keane,** who has retired. Mr. Keane has been associated with the company for the past 30 years.

M. R. Carbone and **J. R. Conaway** have been assigned as technical representatives to the Los Angeles district and the general sales office in New York, N. Y., respectively, of Carbide & Carbon Chemicals Co., New York. **J. A. Francis** has been assigned as technical representative to the St. Louis district, and **A. F. Murray** to the Pittsburgh district.

Ernest L. Puskas and **Robert W. Lea** have joined Thiokol Chemical Corp., Trenton, N. J., as technical representatives for butyl rubber in the Central and Midwest areas, respectively.

George C. Ellis has been appointed a senior vice president of Stauffer Chemical Co., New York, N. Y., and general manager of the company's West End Chemical Co. Division. He was also elected to Stauffer's board of directors. **H. D. Hellmers,** formerly vice president in charge of production for West End Chemical, has been named division vice president of production for Stauffer. Appointed division vice president of sales for Stauffer was **D. G. Ellis,** formerly West End sales manager.

Harry G. Knechtel, since 1953 manager of hose sales and development for Hewitt Rubber Division, Hewitt-Robins, Inc., Buffalo, N. Y., has been appointed manager of sales operations for the division. He succeeds **Charles W. Mackett,** who will retire. **Richard A. Gifford,** since 1950 field engineer in the company's Charleston, W. Va., district office, has assumed Mr. Knechtel's former duties.

Richard D. Boutros has been advanced from chief engineer to vice president and director of engineering at Mixing Equipment Co., Inc., Rochester, N. Y. **Milton Dykman** and **Howard C. Shufelt** have been promoted to chief engineer and assistant to the chief engineer, respectively.

Parrvyn R. Lawson has been appointed head of the racing tire division of The Goodyear Tire & Rubber Co., with headquarters in Dayton, O., He succeeds **Harry Goodenberger,** recently appointed assistant manager of the company's auto tire sales department in Akron.

Col. James E. Baker has been designated chief of the purchasing division of the new single manager Military Clothing & Textile Supply Agency of the Philadelphia Quartermaster Depot, Philadelphia, Pa.

Edward T. King has been appointed director of purchases for Clevite Harris Products, Inc., Cleveland, O.

R. P. Barry, Jr., has been advanced from assistant superintendent to superintendent of the Seadrift, Tex., chemicals and plastics resins plant of Carbide & Carbon Chemicals Co., New York, N. Y. He succeeds **C. M. Blair,** who has been assigned to the company's New York headquarters.

Miles J. Furey has joined Acme-Hamilton Rubber Mfg. Corp., Trenton, N. J., as sales representative to the Philadelphia area.

T. A. Werkenthin, Navy Department, Bureau of Ships, and founder and first president of the Washington Rubber Group, has been given the Navy's Superior Accomplishment Award for his "many noteworthy contributions to the Bureau of Ships' elastomer research and development programs."

W. C. Heidenreich has been appointed associate director of the general industrial relations department of Carbide & Carbon Chemicals Co., New York, N. Y. He has been succeeded as superintendent of the company's Niagara Falls, N. Y., plant by **H. B. Coons,** formerly of the company's South Charleston plant.

John R. Davis has joined the polymer chemicals division of W. R. Grace & Co. and will be assigned to the Baton Rouge, La., polyolefin resin plant now being constructed by the division. He was formerly associated with Shell Chemical Corp.

Norman M. Badger has been appointed assistant sales manager of the automotive wholesalers division of The Dayton Rubber Co., Dayton, O.

G. L. Pitzer, since 1952 works manager for Bakelite Co., New York, N. Y., has been appointed vice president, production.

Albert F. Stahl and **Robert Knippling** have been appointed to the process research section of Emery Industries, Inc., Cincinnati, O., where they will be associated with the production group.

John J. O'Connell has been appointed marketing vice president of Amoco Chemicals Corp., Chicago, Ill., newly formed consolidation of three chemical affiliates of Standard Oil Co. (Indiana). **John W. Bertetti** has been named vice president in charge of manufacturing. Mr. O'Connell was previously manager of the solvents department of Shell Chemical Corp. Dr. Bertetti was formerly general manager of manufacturing of Pan-Am Southern Corp.

Roger S. Firestone, president, Firestone Plastics Co., Pottstown, Pa., has been named president of United Cerebral Palsy, Inc., for 1957.

Roy S. Fisher has been elected vice president and appointed director of sales for National Vulcanized Fibre Co., Wilmington, Del.

Robert J. Ingraham

Robert J. Ingraham has joined Thiokol Chemical Corp., Trenton, N. J., as technical representative for butyl rubber to the Boston and New England areas.

Financial

Allied Chemical & Dye Corp., New York, N. Y. Nine months ended September 30, 1956: net earnings, $35,017,913, equal to $3.64 a common share, compared with $39,376,583, or $4.11 a share, in the like period last year; sales, $498,563,158, against $475,415,566.

American Cyanamid Co., New York, N. Y. Nine months to September 30, 1956: net earnings, $33,353,912, equal to $3.18 a share, compared with $27,254,087, or $2.84 a share, in the corresponding period of 1955.

American Hard Rubber Co., New York, N. Y. Thirty-six weeks to September 9, 1956: net earnings, $739,934, equal to $2.10 a share, contrasted with $482,505, or $1.28 a share, in the 1955 weeks.

American Viscose Corp., Philadelphia, Pa. Nine months ended September 30, 1956: net profit, $10,649,000, equal to $2.09 a common share, contrasted with $18,315,000, or $3.43 a share, in the 1955 period; net sales, $176,229,000, against $195,652,000.

Collins & Aikman Corp., New York, N. Y. Six months ended August 25, 1956: net loss, $287,148, contrasted with net profit of $551,442 a year earlier.

American Zinc, Lead & Smelting Co., Columbus, O. Nine months ended September 30, 1956: net profit, $2,216,147, equal to $1.88 a share, compared with $1,584,391, or $1.34 a share, in the 1955 period.

Anaconda Wire & Cable Co., New York, N. Y. First nine months, 1956: net income, $7,220,330, equal to $8.55 a share, contrasted with $4,651,569, or $5.51 a share, in the 1955 months.

Armstrong Cork Co., Lancaster, Pa. Nine months to September 30, 1956: net income, $9,825,000, equal to $1.89 a common share, contrasted with $11,179,000, or $2.18 a share, a year earlier; net sales, $185,700,000, against $186,613,000.

Baldwin Rubber Co., Pontiac, Mich., and consolidated subsidiaries. Year ended June 30, 1956: net profit, $983,265, equal to $2.28 each on 430,425 capital shares, against $734,790, or $1.70 each on 433,028 shares, in the preceding fiscal year; federal income taxes, $1,040,000, against $878,000.

Brunswick-Balke-Collender Co., Chicago, Ill. Nine months ended September 30, 1956: net profit, $2,242,931, equal to $4.32 a share, contrasted with $907,185, or $1.73 a share, in the like months the year before.

Belden Mfg. Co., Chicago, Ill. Nine months to September 30, 1956: net profit, $1,297,035, equal to $3.34 a share, compared with $960,470, or $2.49 a share, a year earlier.

Sidney Blumenthal & Co., New York, N. Y. January 1-September 30, 1956: net profit, $59,555, equal to 17¢ a share, contrasted with net loss of $1,240,980 in the same months of the preceding year.

Borden Co., New York, N. Y. First nine months, 1956: net income, $16,954,718, equal to $3.58 a share, against $16,018,576, or $3.41 a share, in the first nine months of 1955.

Borg-Warner Corp., Chicago, Ill., and subsidiaries. First nine months, 1956: net earnings, $21,765,742, equal to $2.47 a common share, contrasted with $26,076,149, or $3.29 a share, in the 1955 months; net sales, $435,198,113, against $405,798,190.

Boston Woven Hose & Rubber Co., Cambridge, Mass. Year ended August 31, 1956: net profit, $225,109, equal to 61¢ a common share, contrasted with $287,242, or 71¢ a share, in the preceding fiscal year; net sales, $19,616,358, against $16,326,608; state and federal taxes, $269,000 against $259,000; current assets, $7,030,235, current liabilities, $1,525,990, against $7,082,366 and $1,661,231, respectively, on August 31, 1955.

Carborundum Co., Niagara Falls, N. Y. First three quarters, 1956: net income, $4,528,421, equal to $2.64 a share, compared with $3,929,075, or $2.28 a share, in the corresponding period of 1955.

Philip Carey Mfg. Co., Plymouth Meeting, Pa. Nine months to September 30, 1956: net earnings, $1,779,319, equal to $2.10 a share, contrasted with $2,046,321, or $2.34 a share, in the 1955 months.

Celanese Corp. of America, New York, N. Y. First three quarters, 1956: net income, $8,901,652, equal to 92¢ a common share, against $8,695,015, or 88¢ a share, in the 1955 quarters; net sales, $136,974,216, against $132,358,391.

Columbian Carbon Co., New York, N. Y., and subsidiaries. First nine months, 1956: net income, $4,328,010, equal to $2.68 a capital share, against $4,443,326, or $2.76 a share, a year earlier; net sales, $47,941,030, against $45,854,715.

Crown Cork & Seal Co., Inc., Baltimore, Md. First three quarters, 1956: net income, $1,287,080, equal to 72¢ a share, against $1,268,003, or 71¢ a share, in the 1955 period; net sales $88,513,717, against $85,698,403.

DeVilbiss Co., Toledo, O. First three quarters, 1956: net profit, $1,777,958, equal to $3.27 a common share, compared with $873,168, or $2.34 a share, in the same period the year before.

Diamond Alkali Co., Cleveland, O. January 1-September 30, 1956: net income, $8,032,702, equal to $3.05 a common share, contrasted with $6,255,846, or $2.37 a share, a year earlier; net sales, $92,040,457, against $83,115,419.

Dow Chemical Co., Midland, Mich. Three months ended August 31, 1956: net income, $11,275,315, equal to 47¢ a share, against $11,723,647, or 51¢ a share, a year earlier; sales, $150,784,020, against $128,166,671.

E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., and consolidated subsidiaries. January 1-September 30, 1956: net earnings, $280,621,882, equal to $6.00 a share, contrasted with $291,603,652, or $6.24 a share, in the like period last year; sales, $1,414,729,630, against $1,442,118,692.

Electric Hose & Rubber Co., Wilmington, Del. Year ended August 31, 1956: net profit, $1,139,753, equal to $3.17 a share, compared with $1,075,761, or $2.99 a share, a year earlier.

Flintkote Co., New York, N. Y. Forty weeks ended October 6, 1956: net profit, $4,053,557, equal to $2.70 a share, compared with $3,961,528, or $2.62 a share, in the 1955 months; net sales, $81,900,230, against $79,620,610.

General Cable Corp., New York, N. Y. First nine months, 1956: net profit, $8,725,628, equal to $3.06 a share, contrasted with $4,202,434, or $1.76 a share, in the 1955 months.

General Electric Co., Schenectady, N. Y. Nine months ended September 30, 1956: net profit, $160,727,000, equal to $1.85 a share, against $152,926,000, or $1.76 a share, a year earlier.

The General Tire & Rubber Co., Akron, O., and subsidiaries. Nine months ended August 31, 1956: net earnings, $6,059,025, equal to $3.66 a common share, compared with $6,874,268, or $4.90 a share, in the 1955 period; net sales, $278,192,007, against $209,808,056.

Glidden Co., Cleveland, O., and subsidiaries. Year ended August 31, 1956: net income, $8,146,737, equal to $3.55 each on 2,295,990 capital shares, compared with $7,112,567, or $3.10 each on 2,295,350 shares, for the 10 months ended August 31, 1955: net sales, $226,290,387, against $180,524,822; federal taxes, $8,304,000, against $7,212,000.

Hewitt-Robins, Inc., Stamford, Conn. First nine months, 1956: net income, $785,346, equal to $2.18 a share, against $818,192, or $2.55 a share, a year earlier.

Parker Appliance Co., Cleveland, O. Third quarter, 1956: net profit, $335,706, equal to 87¢ a share, contrasted with net loss of $13,646 in the 1955 quarter.

Hooker Electrochemical Co., North Tonawanda, N. Y., and wholly owned subsidiaries. Nine months ended August 31, 1956: net rofit, $8,638,400, equal to $1.41 a common share, against $7,762,900, or $1.27 a share, a year earlier; net sales, $73,845,700, against $69,220,100.

Monsanto Chemical Co., St. Louis, Mo., and subsidiaries. January 1-September 30, 1956: net profit, $28,812,643, equal to $1.37 a common share, compared with $32,768,562, or $1.54 a share, a year earlier; sales, $407,380,944, against $390,835,150.

Johns-Manville Corp., New York, N. Y., and subsidiaries. Nine months ended September 30, 1956: net earnings, $18,972,546, equal to $2.95 a common share, against $16,441,242, or $2.58 a share, in the like period last year: sales, $228,847,783, against $207,892,376.

A. G. Spalding & Bros., Inc., Chicopee, Mass. Nine months to July 31, 1956: net income $545,000, equal to 95¢ a share, against $695,000, or $1.29 a share, in the 1955 period.

(*Continued on page 484*)

CALENDAR of COMING EVENTS

January 16
Washington Rubber Group. Pepco Auditorium, Washington, D. C.

January 16-18
Society of Plastics Engineers, Inc. Thirteenth Annual National Technical Conference. Hotel Sheraton-Jefferson, St. Louis, Mo.

January 23-25
Twelfth Annual Symposium on Instrumentation for the Process Industries. Texas A & M College, College Station, Tex.

January 25
Akron Rubber Group. Winter Meeting. Sheraton Mayflower Hotel, Akron, O.
Philadelphia Rubber Group, Poor Richard Club, Philadelphia, Pa.

January 28-31
Plant Maintenance & Engineering Show and Conference. Public Auditorium, Cleveland, O.

February 1
Detroit Rubber & Plastics Group, Inc. Winter Meeting.

February 5
The Los Angeles Rubber Group, Inc. Hotel Statler, Los Angeles, Calif.

February 7
Fort Wayne Rubber & Plastics Group. Van Orman Hotel, Fort Wayne, Ind.

February 13
Washington Rubber Group. Pepco Auditorium, Washington, D. C.

February 15
Chicago Rubber Group. Furniture Mart, Chicago, Ill.

March 5
The Los Angeles Rubber Group, Inc. Hotel Statler, Los Angeles, Calif.

March 15
Chicago Rubber Group. Furniture Mart, Chicago, Ill.

March 18-21
Society of the Plastics Industry, Inc. 1957 National Conference and Pacific Coast Plastics Exposition. San Francisco, Calif.

March 20
Washington Rubber Group. Pepco Auditorium, Washington, D. C.

April 2
The Los Angeles Rubber Group, Inc. Hotel Statler, Los Angeles, Calif.

April 5
Akron Rubber Group. Spring Meeting. Sheraton Mayflower Hotel, Akron, O.

April 8-10
American Society of Mechanical Engineers. Spring Meeting. Hotel Dinkler-Tutwiler, Birmingham, Ala.

April 11
Fort Wayne Rubber & Plastics Group. Van Orman Hotel, Fort Wayne, Ind.

April 14-27
United States World Trade Fair. Coliseum, New York, N. Y.

April 26
Chicago Rubber Group. Furniture Mart, Chicago, Ill.

May 7
The Los Angeles Rubber Group, Inc. Hotel Statler, Los Angeles, Calif.

May 15-17
Division of Rubber Chemistry, ACS, and Rubber Division, CIC. Joint Meeting. Sheraton-Mt. Royal Hotel, Montreal, P.Q., Canada.

May 22-24
American Society for Quality Control. Eleventh Annual Convention and Exposition. Masonic Temple, Detroit, Mich.

June 7
Fort Wayne Rubber & Plastics Group. Outing. Lake Tippecanoe, Leesburg, Ind.

News from Abroad

Malaya

Exports to Red China Begin Without End-Use Guarantees

After an interval of more than five years the first rubber exports to China left Singapore about the middle of October. In all, 350 tons of sheet rubber were loaded for Tientsin and 50 tons of latex for Shanghai, and stops were to be made at Jakarta, Semarang, and Soerabaya on the way to China. About 10 days later the first Federation shipment of 1,300 tons left Port Swettenham, and almost simultaneously Singapore sent a second consignment of 400 tons to Tientsin and 50 tons to Shanghai.

For a while it looked as though government insistence on guarantees by Chinese buyers that the rubber will be used for civilian purposes only, would break off the newly resumed trade relations. The Federation Government shifted its position, however, to the extent that it was prepared, for the present, to grant licences without these guarantees though it pressed the point that traders must first try their best to get certificates from Chinese buyers on the end-use of the rubber. The Singapore Government took a similar stand, stipulating that, if possible, application for licences should include the names of the factories or other users of the rubber.

The Minister for Commerce and Industry intimated that the present leniency in regard to the certificates would not continue; the government had ways of estimating the amount of rubber China required for civilian needs, he stated, and once these needs were met, exporters would have to convince the government very fully before further quantities of rubber would be allowed to be exported to China.

It may be added that to the end of October no further orders beyond the original 7,200 tons had been received from China; also, that observers find that local enthusiasm for this business is waning considerably.

Imports and Exports

During the first nine months of 1956, Malaya exported 725,126 tons of rubber and latex, or 26,224 tons less than in the same period last year. The 1956 shipments included 467,074 tons of Ribbed Smoked Sheet, 4,560 tons more than in 1955. The total figure for September, 1956, at 94,379 tons, was the highest for any month since 1951 and included 63,759 tons of Ribbed Smoked Sheet, as compared with 52,004 tons in September 1955.

The United Kingdom, which again was Malaya's best customer, increased her purchases by 6.8% to 179,421 tons, almost 25% of total Malayan exports. On the other hand, the share of the United States dropped 19% to 114,468 tons; West Germany, now Malaya's third best customer, also bought less—59,228 tons, against 66,958 tons. Japan, which has been steadily increasing her purchases of rubber in Indonesia and Malaya, took 55,902 tons, against 53,780 tons, and Russia took 12,791 tons, against nothing last year.

Rubber imports into Malaya in September, 1956, were 29,245 tons, a drop of 31% from the August total of 42,662 tons, the highest in 17 months. The imports for the first nine months of 1956 showed a slight increase over those for the same period last year, going from 273,335 to 273,911 tons.

Recent Advances in Latex

The broad objective of latex research at the Rubber Research Institute of Malaya is to improve control of concentrate preparation and thus produce better and more uniform latex, with an eye particularly to retaining the foam rubber market in the competition with synthetic latex.

A review of work in this field during 1955, published in *The Planters' Bulletin*, for September, 1956, presents interesting new information on various problems. An analysis of data collected in a study on variability of latex concentrate suggests that lack of uniformity in field and factory procedures may be more important than seasonal changes in causing variability in commercial supplies.

Of new systems tested for preserving latex concentrate, the most promising is considered to be a combination of 0.2% boric acid and 0.05% lauric acid with 0.2% ammonia. The sterilization of field latex and concentrate by irradiation with ultra-violet light and by means of ultrasonic vibrations proved feasible; it now remains to discover whether these methods can be used in combination with preservations in commercial practice.

An accelerated storage test for latex has been developed as a guide for assessing the behavior of a concentrate at a later date. This test is based on the observation that rate of change in properties of stored latex is accelerated at higher temperatures. These observations could also be utilized to produce a latex concentrate with much more constant properties. Latex concentrates heated for a few hours at 80° C. show a low mechanical stability of the order of 100 seconds, which remains unchanged after some months' storage. Addition of suitable stabilizers gives concentrates of the required mechanical stability and good behavior on coagulation, with properties which remain reasonably constant over long periods. Because of the costly problem of heating larger amounts of concentrate, however, this work has been discontinued for the present.

Recent investigations have confirmed earlier findings that the presence of oxygen is a most important factor in controlling the rate at which mechanical stability of latex concentrate increases after preparation. It has also been shown that in any one concentrate the amount of soap-forming fatty acid increases on storage along with mechanical stability. Further studies are being undertaken to correlate oxygen absorption with the development of mechanical stability and the soap-forming propensity of naturally occurring acids.

Replanting Material

A new scheme, to cost $5,000,000 (S.S.), has been started to provide smallholders with high-grade planting material for replanting. Under the scheme the rubber nurseries maintained by the Rubber Industries (Replanting) Board will be taken over by the board of administrators, and more nurseries will be set up; these will be financed by a revolving fund controlled by the board. At present there are about 60 acres of budwood nurseries, laid out between 1951 and 1956.

Japan

SRF Aims, Organization, Objectives

The Society of the Rubber Industry, Japan, established in 1932, is an incorporated society formed to promote friendly relations between rubber technologists and to improve their technique and knowledge. It now has 1,911 members, including, besides rubber experts and persons directly interested in rubber, special members and organizations supporting the Society's aims. Annual meetings are held in the spring, at which progress is reported, and lectures are given. Through its main office the Society publishes the *Journal of the Society of the Rubber Industry* as well as books; organizes special lectures and training courses; and encourages rubber research. Local lectures, social gatherings, and the like are arranged by several branch offices.

Committee Work

The Society includes various committees, the most important of which is the Rubber Engineers' Association of Japan, which is practically a standing committee. At present this Association has 22 subcommittees under it, each working on specific problems of its department. A problem, usually submitted by government and industrial organizations, is first considered by the Secretaries' Council of the Association; if this council can find no immediate

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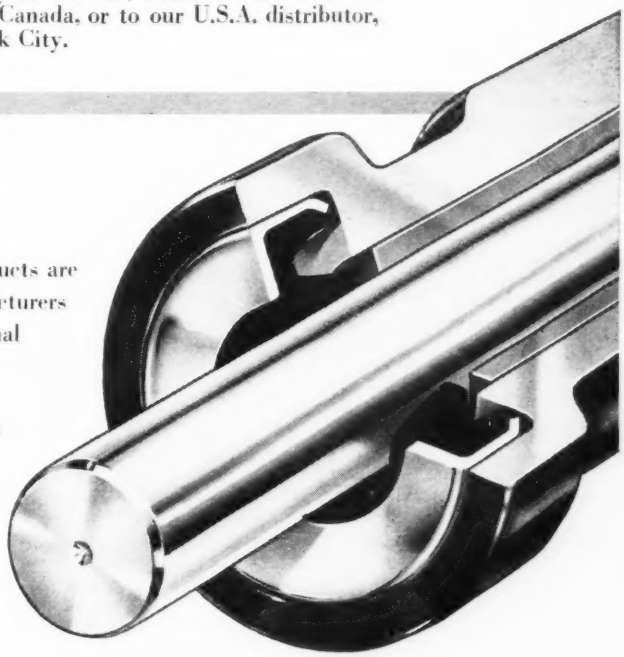

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solution, the question is passed on to the appropriate sub-committee consisting of specially recommended and qualified engineers and scientists.

From a summary of recent and current activities of these sub-committees, some examples are selected which give an idea of the scope of their work.

Thus sub-committee No. 4 is working on the improvement of the quality of domestic furnace black. No. 14 studies high-tenacity rayon cord for cycle tires: it conducted tests on adhesion and methods of obtaining better adhesion of rayon cord and rubber: it also prepared a revised draft of specification standards for cycle tubes, studied methods to increase efficiency in manufacturing and equipment, and investigated materials with the aim of improving quality of export tires.

No. 23 drafted specifications for synthetic rubber compounds used in electric wires and cables, considered specifications for chloroprene and butadiene-styrene copolymer compounds, and worked on identification and analysis of synthetic rubber. No. 25 is investigating recent improvements in rubber processing machinery: No. 27 is carrying out research on purified rubber, testing its use in the food industry and for electrical purposes.

No. 30 is concerned with synthetic rubber; No. 31 occupies itself with testing apparatus and methods, and its activities include revision of standard specifications on testing cured rubber: No. 32 deals with specifications and testing methods for latex and casein.

The various committees are dissolved when their tasks are completed.

In 1949 a Foundation Rubber Goods Inspection Association was established, the only one of its kind in Japan. Its aim is to improve the quality of rubber goods for export as well as for home consumption: it promotes testing and investigations of rubber goods, technical guidance, and studies.

The Foundation Rubber Research Association operates a laboratory in Tokyo, chiefly for the benefit of small and medium-size rubber manufacturers and rubber chemical companies. The Foundation, moreover, conducts tests and trial manufacturing of rubber goods on request, provides information and guidance on technology and test methods, and also training courses in rubber technology.

Matsudaira President

The President of the Society of the Rubber Industry in Japan is Nobutaka Matsudaira, who recently visited the United States. Mr. Matsudaira is also the executive director of Bridgestone Tire Co., Ltd., the largest tire manufacturer in Asia. Established in 1931, it celebrated its twenty-fifth anniversary on April 25, 1956. The company is capitalized at 2,500,000,000 yen (about $7,000,000); in 1955, sales totaled about $33,600,000, and the estimate for 1956 is about $42,000,000. The concern has three plants—the extensive, modern works at Kurume (where the 8,700,000th automobile tire was recently produced), besides a factory in the Yokohama area and another in Akabane.

Bridgestone has a technical arrangement with Goodyear, and it is interesting to learn that during the Japanese occupation of Java, the government put it in charge of the Goodyear plant in Buitenzorg (now Bogor). The president of the company, Shojiro Ishibashi, takes pride in the welfare work for his employes (there are 3,600 in all): they are provided with up-to-date housing, medical care, markets, club houses, facilities for various sports, and schools. Mr. Ishibashi is a collector of western and Japanese paintings and sculpture, and an entire floor of the fine Bridgestone building in Tokyo, which houses the company's main offices, is occupied by an art gallery open to the public.

East Germany

Oil-Plasticized Rubber

Oil-plasticized Buna rubber has now also been developed at the National Chemical Works, at Schkopau, East Germany. According to details revealed in a lecture by H. Luttrop for the Leipzig Spring Fair, 1956, the starting material for Buna SO, as it is called, is Buna S3 in the latex state.

As latex, Buna S3 is soluble, but after it has been separated and dried, it loses this property; as dry rubber it cannot be processed without preliminary thermal degradation. The oil plasticizer seems to attach itself to the elastomer in a different way if it is added to Buna latex than if it is incorporated in the dry Buna; the resultant product is more soluble, so that it is concluded that the oil particles built into the latex may to some extent inhibit the tendency of the dry rubber to become insoluble.

The most useful plasticizer found is a combination of definite proportions of aromatic-naphthenic plasticizers with aromatic and ester plasticizers. Oil-plasticized Buna is produced with varying plasticizer content: Buna SO 40 (with 40 parts by weight of plasticizer to 100 parts by weight of Buna) is the most widely used product. It has an initial Defo hardness of about 800 and is obtained in crumb form; this is packed in a PVC bag and then in a five-ply paper bag. Pressure in storage causes the material to adhere and form a more or less homogeneous block which, when unwrapped, may present dark-brown areas or pale grey-brown patches; these discolorations, it is said, have nothing to do with quality and result merely from the various pressures in storage.

Buna SO 40 is best milled at a low temperature—around 20° C.—when a coherent band soon forms around the roll. It is frequently necessary to add further plasticizer (2-5%) during compounding to improve dispersion of fillers. To insure adequate tensile properties, the carbon black content must be increased, and the proportion of curing agents suitably adjusted, precautions even more necessary for oil-plasticized than for ordinary Bunas, it is stressed. The improved tensile value, however, is obtained at the cost of lower rebound elasticity.

Tests on the milling and extrusion properties of Buna SO mixes containing varying proportions of carbon black (0-100 parts by weight), and also of white fillers, revealed very good results with 40-50 parts of carbon black; the properties of the compounds with precipitated chalk, China clay, and alumina gel were far less satisfactory. The mechanical values of vulcanized Buna SO were also highest with 40-50 parts carbon black, but the values for tensile, abrasion, and rebound elasticity were not quite up to those of similar Buna S4 and S3 compounds, though extensibility and tear resistance were better. Useful compounds were also obtainable with the larger proportions of alumina gel as filler.

Since Buna S3 latex used for making oil-plasticized rubber is stabilized with phenyl-naphthylamine, which affects color, Buna SO 40 is not recommended for light hued goods or for purposes where it would come in contact with food. Suitable stabilizers for these uses have not yet been produced at Schkopau. This Buna is at present being used in East Germany for making various types of hose, footwear uppers, heels and soles; it is also serving as material for V-belts, household and industrial aprons, and air cushions.

Current investigations focus on the possibilities of this rubber for cycle tires, and also, alone or in combination with Buna S3, for motor vehicle tires. So far, indications appear to be that the performance of heavy-duty tires in particular is on the whole poorer than that of all-Buna S3 tires. Another series of tests seems to show that the adhesion of cotton and rayon cord to Buna SO 40 Buna S3 or /Buna S4 compounds is satisfactory.

Ceylon

Latex Corp. for Sale

Latex Corp. of Ceylon, Ltd., established by Dunlop in 1951 to produce concentrated latex, is reportedly for sale. The enterprise was started with an eye to future supplies of latex in connection with plans and specifications of the Dunlop Group for the production of Dunlopillo. However, plans and specifications have been changed, and the corporation, never profitable, has for some time been operating considerably below economic capacity.

South Korea

Tire Manufacture to Begin

The manufacture of automobile tires is soon to be started by Eun Sung Industrial Co., Ltd., Seoul, in a factory now nearing completion in South Korea, it is learned. Through its Singapore representative the firm has bought more than 3,000 tons of smoked sheet from Malaya in a period of five months (considerably more than normally bought) to supply the new plant as well as its present three factories where shoes and bicycles are being produced, mostly for home consumption.

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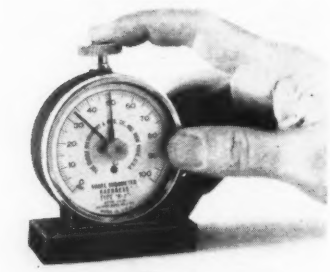
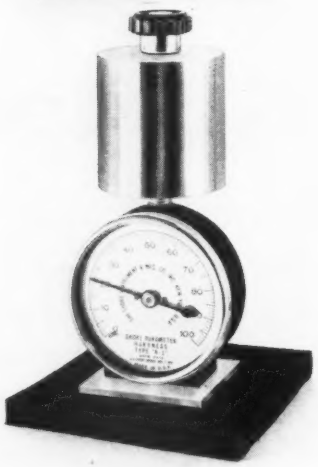
NEW EQUIPMENT

Special-Purpose Shore Durometers





Maximum Reading Durometer *(top)*; Constant Load Durometer

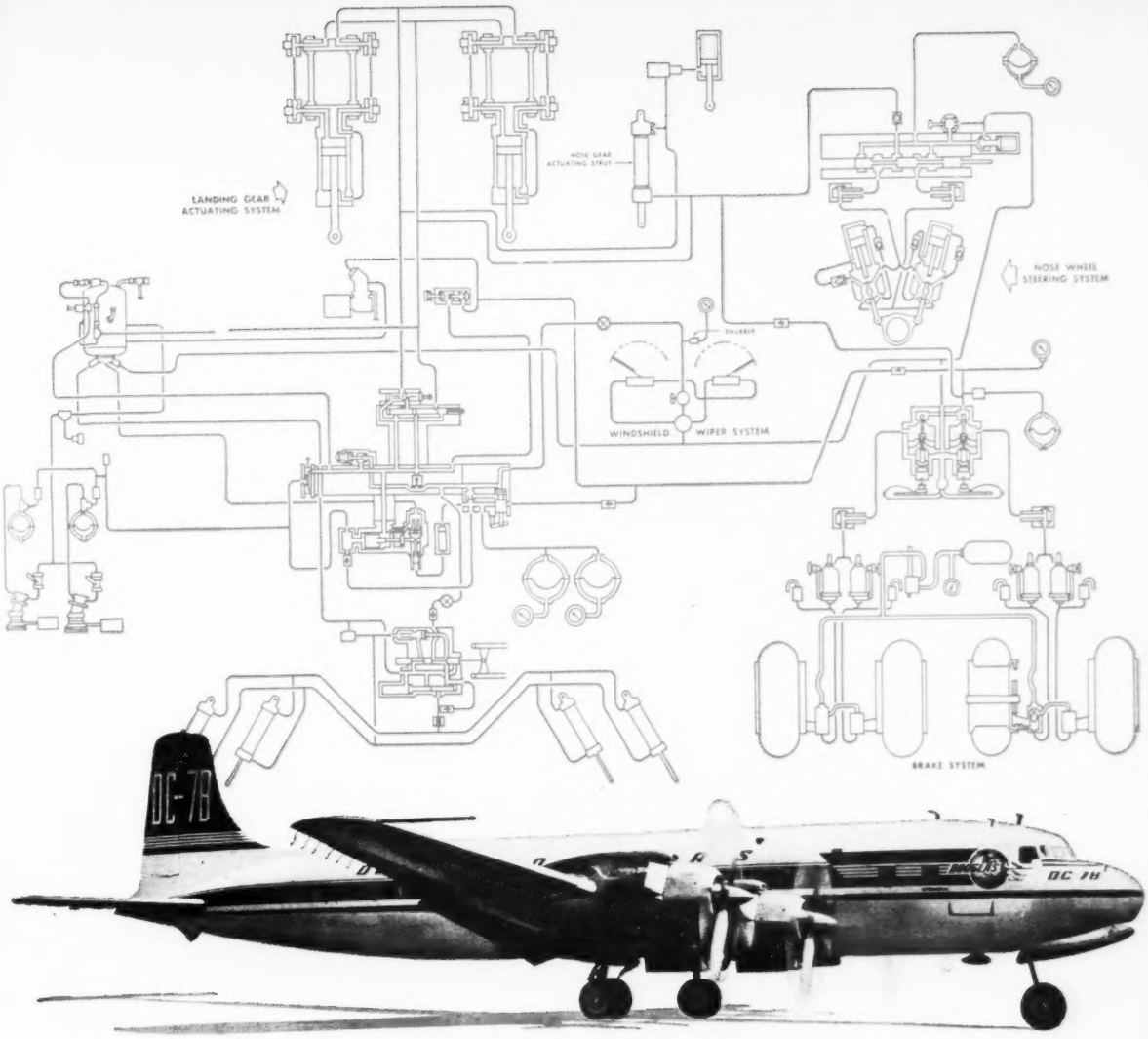
Two special-purpose Shore durometers for testing the hardness of rubber and other elastomeric materials have been introduced to the market by Shore Instrument & Mfg. Co., Inc., Jamaica, N. Y. A Maximum Reading Durometer measures cold flow or creep of elastomers and embodies both a driving hand and a maximum hand, the two hands moving in tandem. After indicating the hardness of a specimen, the driving hand recedes proportionately to the extent of creep or cold flow inherent in the specimen. The maximum hand remains fixed at the maximum reading attained. This allows the recording of both the maximum reading and the reading yielded by the driving hand after a stated time interval, which is usually 10-30 seconds.

The second Shore instrument, a Constant Load Durometer, is designed to minimize the possibility of variations in readings resulting from variable pressures of manual application of the durometer to the test specimen. A modification of the standard A-2 durometer, it incorporates a two-inch-square bottom plate and a dead weight attached to the top of the instrument. The combined mass of the dead weight and its holding screw is 822 grams, which is the maximum durometer mainspring pressure as defined in ASTM D676. The total weight of the Constant Load Durometer is about 1,065 grams, or just sufficient to insure a firm contact of the bottom plate with the test specimen.

Fife Automatic Guiding Equipment

New automatic guiding equipment with multiple power units has been introduced by Fife Mfg. Co., Oklahoma City, Okla. Hydraulically actuated, the machines are applicable to the guiding of plastic films, rubber fabrics and cloths, paper, foils, and other materials. One model, the MPA-2 power unit, is said to accomplish two automatic guiding jobs and can be used for guiding into printing and into rewind on any type of press when used in conjunction with the Fife cambering roller guiding method and assemblies.

The company's MPA-3 automatic guiding power unit can handle three guiding problems; while the MPA-6 automatic guiding power unit can handle four, five, or six guiding tasks.



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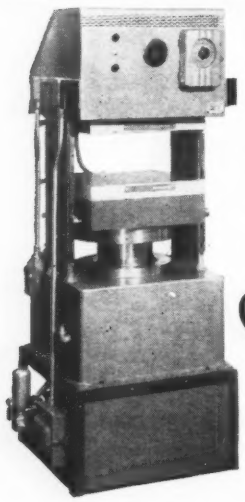

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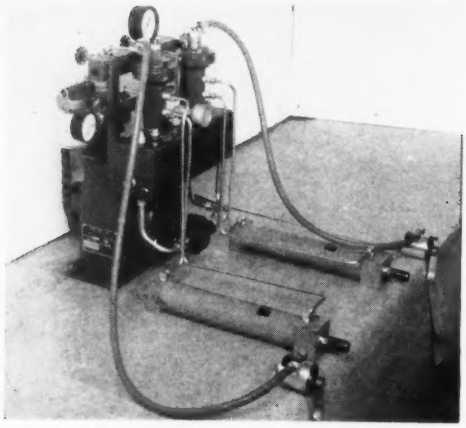


MPA-2 power unit in operation

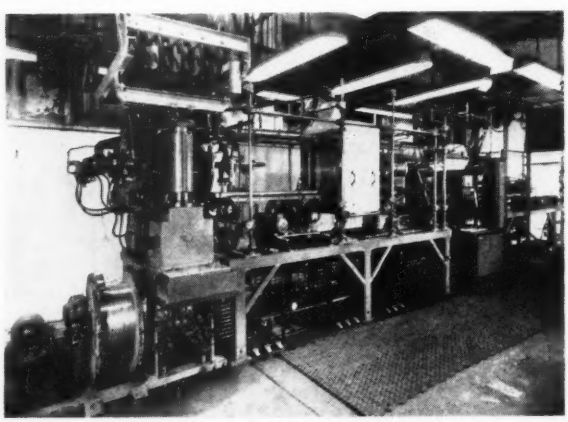
According to the company, these units are especially applicable to printing presses, combining and laminating machines, or can be installed on separate machines if they are in the same vicinity.

National-Standard Swaging Machine

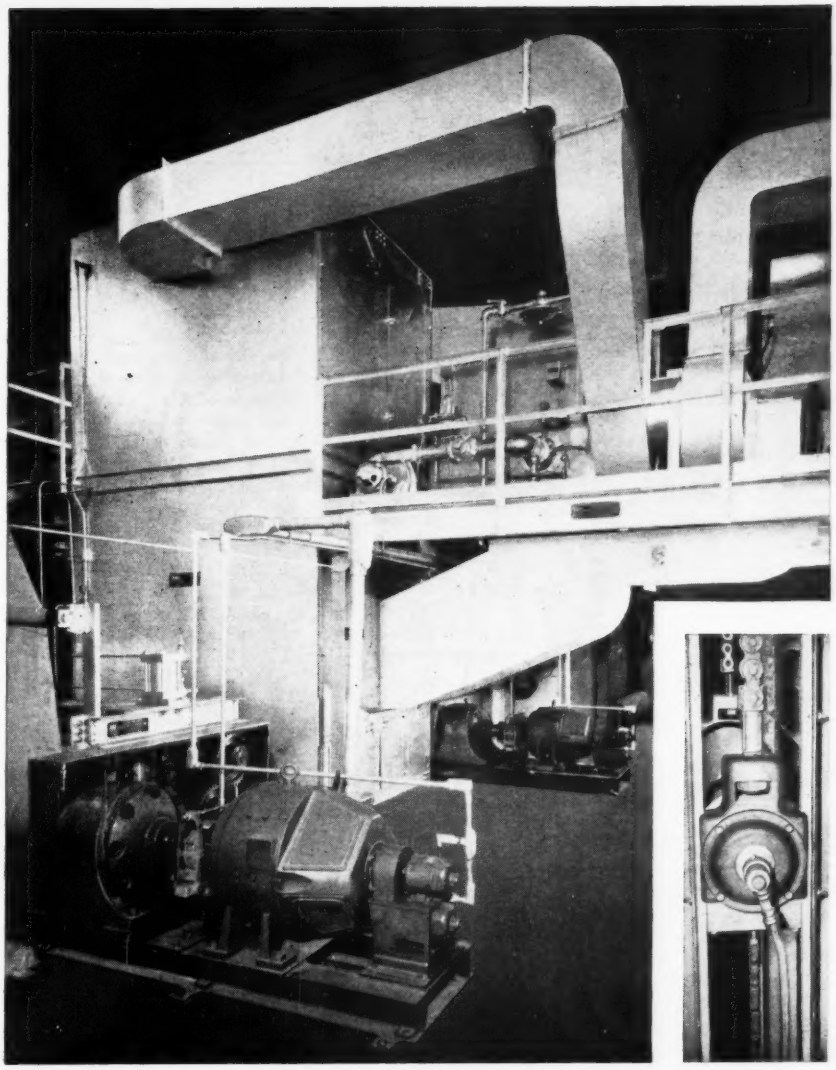
National-Standard Co., Niles, Mich., will market a swaging machine for the manufacture of bicycle tire beads produced by its subsidiary, National-Standard Co., Ltd., Kidderminster, England. The British firm was recently granted a U. S. patent on the machine, which can turn out a total of 600 bicycle-tire beads an hour.

The machine swages, or hammers, a reinforcing sleeve covering the threaded ends of two wires so that it tightly grips the wire, resulting in what is said to be a union stronger than possible through welding or other methods. The machine resembles conventional rotary swagers in that the hammering action is provided by a pair of dies pressed against the work by roller cams. It departs from established machines, according to National-Standard, in that it has a slot that makes it possible to remove a continuous loop of wire from the machine after the swaging operation is completed. The wires are joined by swaging instead of automatic welding because it eliminates the possibility of undesirable tempering of the metal.

Most American bicycles use low-pressure balloon tires with multiple strand beads, usually 0.037- or 0.025-inch, that do not impose the forming problems of the more rigid single-wire beads. The beads produced by the British machine will go into the manufacture of high-pressure bicycle tires. The bead making machine will be manufactured in the United States if there is sufficient demand for domestic lightweight bicycles with high-pressure tires.



Continuous process bicycle-tire bead machine



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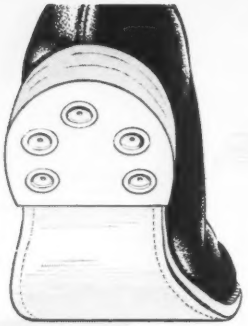

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NEW MATERIALS

Union Carbide OrganoFunctional Silanes

Four organosilanes to which functional groups have been added are being made available in semi-commercial quantities by the silicones division of Union Carbide Corp., New York, N. Y. Designated Union Carbide OrganoFunctional Silanes, they can be reacted with organic chemicals as organic chemicals, resulting in such possible end-products as lubricants, emulsifiers, anti-static agents, synthetic resins, and flame-retarding materials.

The four organosilanes are designated X-1901 (*gamma*-aminopropyltriethoxysilane); X-1902 (*delta*-aminobutylmethyldiethoxysilane); X-1911 (*beta*-carbethoxyethyltriethoxysilane); and X-1912 (*beta*-carbethoxyethylmethyldiethoxysilane). They are water-white liquids, stable to light, which can be distilled at atmospheric pressure, and are completely miscible in acetone, benzene, methyl Cellosolve, chloroform, dioxane, ethanol, ethyl acetate, heptane, toluene, and water (hydrolysis). No polymerization or viscosity change takes place if these silanes are stored in closed containers.

Some physical properties of X-1901, X-1902, and X-1911 have been reported by Union Carbide as follows:

	X-1901	X-1902	X-1911
Molecular weight	221.3	205.3	264.4
Density @ 25° C.	0.942	0.905	0.942
Viscosity @ 25° C., centistokes	1.6	2.03	16.7
Flash point (Cleveland open cup), °F.	220	200	235

The uses and reactions of these OrganoFunctional Silanes are described in a 16-page illustrated booklet, which is available from the company.

Duolock Rubber-to-Metal Bonding

A primer/tie coat system that is said to provide a superior system for bonding all rubbers to metals has been announced by the adhesives division of B. F. Goodrich Industrial Products Co., Akron, O. Called Duolock, the primer is a free-flowing, single-phase, black liquid supplied at a viscosity of 95 centipoises with a solids content of 22%, suitable for brushing as supplied. Duolock tie coats recommended for use with the primer are A-836-B, for natural rubber goods and SBR; A-219-B, for nitrile rubber; A-736-B, for neoprene; and A-771-B, for butyl rubber.

According to the company, testing of the system has revealed that superior bonds may be obtained over a wide range of curing conditions, such as long low-temperature or short high-temperature cures. The results of these tests on a variety of natural, SBR, nitrile, neoprene, and butyl rubber stocks are reported in a company bulletin, No. 8200, entitled, "B. F. Goodrich Duolock System for Bonding Rubber to Metals," which is available on request. Procedures for use of the primer and tie coats are also given.

Adweld Adhesive for Non-Porous Surfaces

A new synthetic solvent-based adhesive for non-porous surfaces, such as natural and synthetic rubber, plastic, and metal has been placed on the market by Adhesive Products Corp., New York, N. Y. Designated Adweld, it is said to provide a flexible, shock-resistant bond which is impervious to most oils, acids, and alkalies, and does not soften at elevated temperatures or become brittle when cold. A one-part cement, it can be applied by brush, spray, or coating machine. It can also be used for attaching materials to molded fiber-glass products and low-pressure plastic laminates.

To help meet the increasing world-wide demand for synthetic rubber, the production capacity of ASRC is being expanded by 50%.

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ASRC 1502	Non-staining
Cold Oil	
ASRC 1703	Non-staining
ASRC 1708	Non-staining
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ASRC 1000	Staining
ASRC 1001	Slightly staining
ASRC 1004	Staining
ASRC 1006	Non-staining

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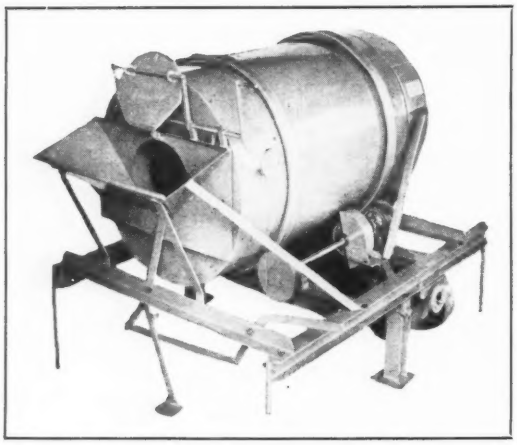

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Oakite Liqui-Det Concentrated Detergent

A new concentrated liquid detergent for industrial and other uses has been placed on the market by Oakite Products, Inc., New York, N. Y. Called Liqui-Det, it is said to go into solution instantly, developing copious suds in hard or soft water. It can be used repeatedly without rinsing and without causing build-up of film or discoloration, according to the company. Among the suggested uses of the detergent is the removal of rubber "burns" from fork-lift tires on concrete.

U. S. Rubber Highly Purified Natural Rubber

A natural rubber of extremely high purity is being made available by United States Rubber Co., plantation division, New York, N. Y. Designated highly purified natural rubber 2103A, it consists substantially of rubber hydrocarbon from which the surface nitrogen has been removed, leaving the rubber surface clean and uncontaminated by water-absorbent material, such as protein.

Natural rubber 2103A is said to age well in storage and has extra resistance to aging after cure. Light in color and uniform from lot to lot, it will cure normally in the usual formula to give excellent physical properties, according to U. S. Rubber. The nitrogen content of the rubber is reported to be 0.03% or less; ash content 0.2% or less; and the acetone extract, almost entirely fatty acid, is about 3.5%. Suggested applications of the rubber are electrical insulation, rubber hose exposed to high temperatures, packing materials, and other products requiring extreme resistance to water absorption.

The process for making the highly purified natural rubber involves the simple washing of the rubber particles in the latex as they come from the rubber tree, removing almost all of the water-soluble ingredients. This eliminates excessive mastication on a mill or excessive chemical or heat treatments, which result in deterioration of the rubber. The virgin latex particles are then cleaned of protein and spray dried. A substance which protects against copper, manganese, iron, and other metals is introduced into the rubber before spray drying.

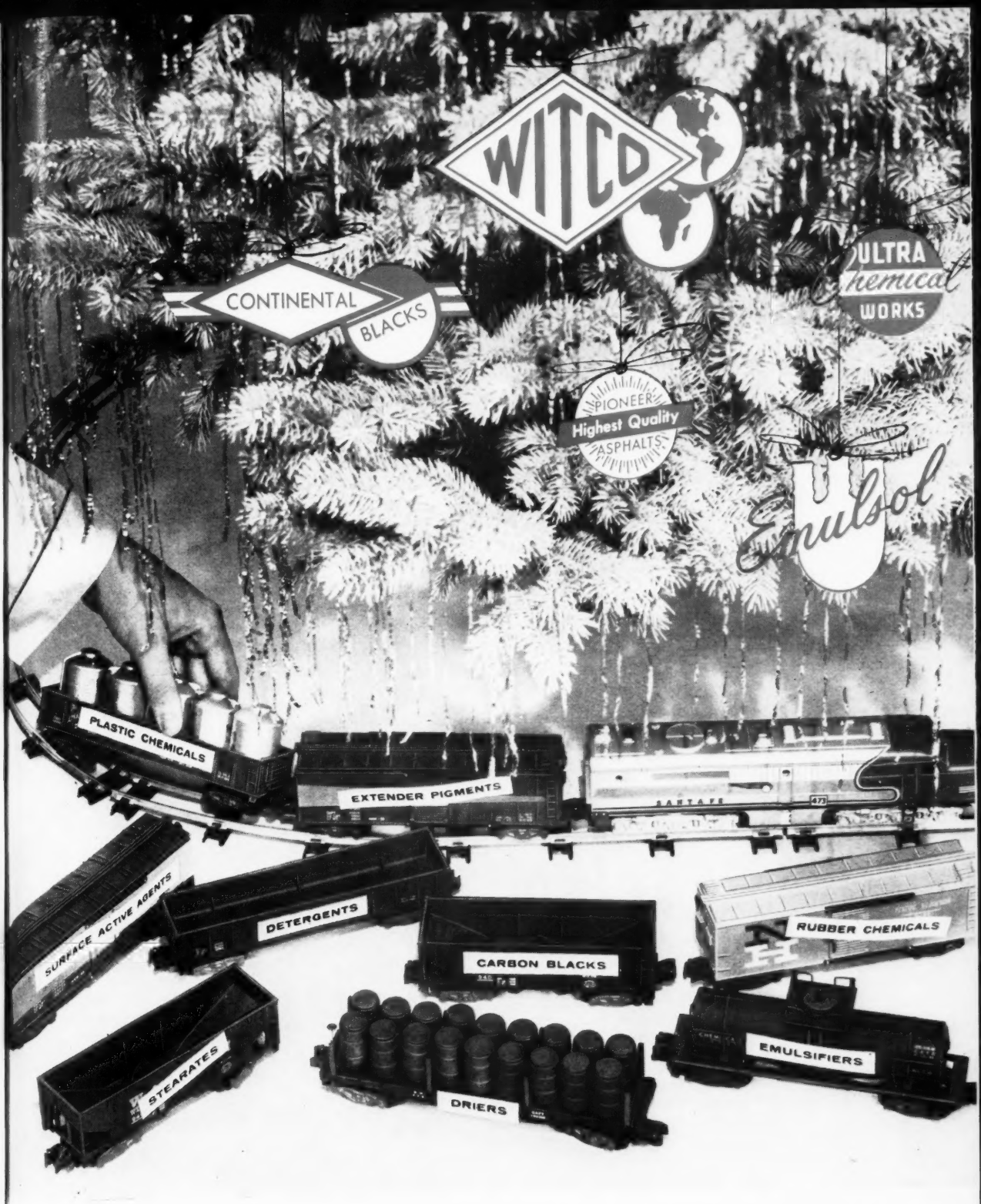
SE-751 High-Temperature Silicone Rubber

A low compression set silicone rubber that can withstand intermittent temperatures as high as 600° F. has been added to the line of the silicone products department of General Electric Co., Waterford, N. Y. Designated SE-751, this 50 durometer hardness compound is designed particularly for extruded door gaskets for domestic and industrial ovens and can be cured by steam or the continuous hot-air vulcanization process. Some molding and calendering operations are also feasible for the rubber.

The transparency of cured SE-751 is said to permit almost any desired degree of tinting or coloring. Rubbers of higher durometer hardness can be made from the rubber by the addition of certain diatomaceous fillers such as Celite Super Floss. A member of the company's Class 700 silicone rubber compounds, SE-751 will withstand prolonged exposure to ambient temperatures of 480° F. and will retain some flexibility after one week's exposure to temperatures as high as 600° F. Properly fabricated SE-751 parts can qualify under AMS 3302 and ASTM D735 TA BE_1 E_3 F_2L.

Some physical properties of SE-751 after a one-hour oven cure at 300° F. are as follows:

Specific gravity	1.19
Density, lb./in.^{3}	.04
Hardness, Shore A	50
Tensile strength, psi	950
Elongation, %	210
Tear strength, ASTM D624 Die B., lb./in.	60
Linear shrinkage, %	2
Compression set, ASTM D395 Method B, %	
22 hr./158° F.	6
300° F.	20
70 hr./300° F.	30
22 hr./350° F.	40
Brittle point, ° F., ASTM D736	−85



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NEW PRODUCTS

Ease of installation of Gates Rubber fold-up spare tire being demonstrated

Provisional Fold-Up Spare Tire

A spare tire that folds into a package the size of a football has been introduced by Gates Rubber Co., Denver, Colo. The tire is intended to save trunk space and, with a tread life estimated at only 1,000 miles, has been designed as provisional equipment until the flat tire it has replaced can be changed to a regular tire. Accompanying the "fold-up" spare tire is a kit containing a tire puller, used to remove the flat tire from the wheel, and a small cylinder charged with carbon dioxide gas for inflating the spare. The reusable tire can be deflated upon changeover and refolded in its container. With a nylon-reinforced carcass, the fold-up tire can be driven to the nearest service station at regular highway speeds, according to Gates Rubber.

Anti-Corrosion Neoprene Tubing Caps

Neoprene slip-over and roll-on end caps for sealing out air, moisture, corrosive fumes, dust, and small animals from expensive alloy pipe and tubing are being marketed by Protokap, Inc., Houston, Tex., Trade marked Protokap, the caps are said to be made particularly effective against corrosion of pipes by adding some dehydrating agent within the cap head. The caps are also effective for protecting heat exchanger tube bundles, well casing, and other tubular goods for oil field and refinery applications.

Available are a lightweight roll-on cap for pipe 2-10 inches in diameter and a heavier slip-on cap for 2- to 20-inch-diameter piping. The standard slip-on covers have a wall thickness of about ⅛-inch.

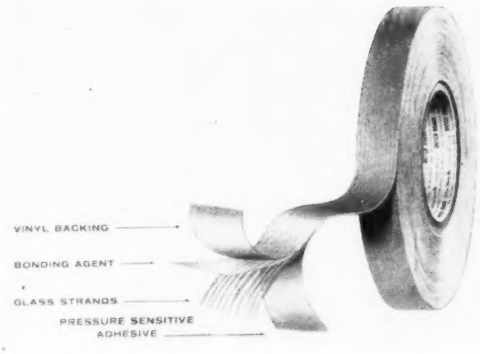
Goodyear Pliotac Contact Adhesive

A new contact adhesive that is said to remain permanently flexible after application is being offered by the coatings department of the chemical division of The Goodyear Tire & Rubber Co., Akron, O. Dubbed Pliotac, it is a light-colored material containing 25% solids and is reported to have good bond strength, excellent tack, and low-level dry film odor. Water and moisture resistant, the adhesive is applied by brushing or spreading with a notched trowel and can be sprayed when diluted with toluene. Pliotac is recommended for joining any combination of foam rubber, natural fiber textiles, plastics, fiber glass, plywood, metals, plaster, concrete, and ceramics.

Deluxe Silvertown

New BFG Tubeless Passenger Tire

A new tubeless passenger-car tire in 14-inch and 15-inch sizes is being marketed by B. F. Goodrich Tire Co., Akron, O. Designated Deluxe Silvertown, the tire features the company's inner liner which provides puncture resistance and protection against bruise blowouts, and a narrow whitewall without lettering. The new tread design is said to run quietly, give an easy ride, and afford maximum traction and skid resistance. The tire will fit 1956 and older cars, as well as 1957 models.



Dutch Brand No. 400 Strapping Tape

Vinyl-Reinforced Strapping Tape

Pressure-sensitive strapping tape reinforced with vinyl-film backing and containing glass strands has been placed on the market by Dutch Brand Division of Johns-Manville, Chicago, Ill. Designated Dutch Brand No. 400 Strapping Tape, it is said to have a tensile strength of 250 psi. and a holding power of 68-72 psi. It resists abrasion, salt water, acids, and alkalies and is rust-, mildew-, water-, oil-, and grease-proof, according to the company. Flexible enough to conform to irregular surfaces, the tape is said to be easy to apply by hand or with standard taping machines.

Applications are for packaging, package reinforcing, bundling, palletizing, unitizing, and tear stripping. No. 400 Strapping Tape meets U. S. Federal Specification PPP-T-0097a Type II and is available in standard widths starting from ¼-inch in 60-yard rolls, with longer lengths available on special order.

U. S. Royal Safety 8

A passenger tire, said to be designed to keep a car steadier on turns and to stop it 25% quicker on wet roads, has been announced by United States Rubber Co., New York, N. Y. Called U. S. Royal Safety 8, the tire has a tread compound which is more resistant to abrasion, and a new tread pattern with many more wiping edges for faster stops on wet surfaces and increased resistance to sideways skid, according to the company.

The white sidewalled Safety 8 is available in 14-inch and 15-inch sizes, in tubeless or tubed constructions, and with nylon or rayon cord. Other improvements incorporated in the tire are a more airtight lining for the tubeless type, a strengthened rim area, and narrower sidewalls for a lower-appearing car silhouette, U. S. Rubber reports.

Another coating problem solved by Borden . . .

versatile Plastisol finish gives industrial gloves iron-hand strength with kid-glove comfort

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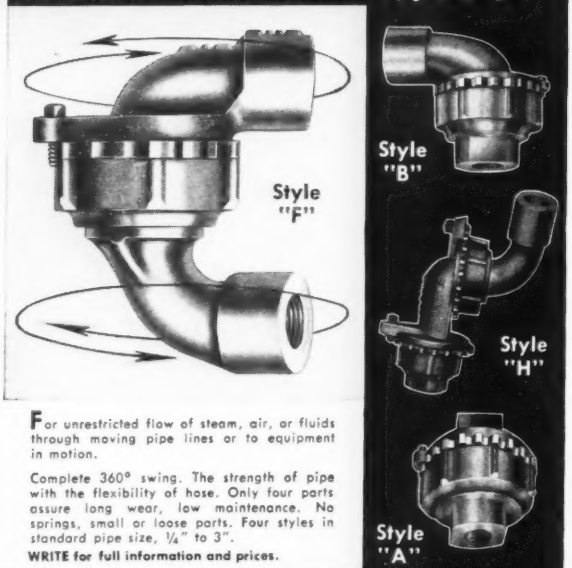

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TECHNICAL BOOKS

BOOK REVIEWS

"Gummiteknisk Handbok." Published by The Swedish Institution of Rubber Technology, P. O. Box 7310, Stockholm 7, Sweden. Cloth, 6 x 8½ inches, 328 pages. Price $8. Available in U. S. A. from RUBBER WORLD, New York 16, N. Y.

This is the second, revised and enlarged, Swedish and English, edition of the Swedish Handbook for the Rubber Industry, the first edition of which appeared four years ago. The main portion of the work is devoted to a classified list of 25 groups of raw materials and compounding ingredients, the first of which includes natural rubber and gives descriptions of United States Rubber Manufacturers Association types, also of Technically Classified rubber, sole crepe and latices; the Swedish dealers handling the different categories are listed under the individual heads.

In the other sections, dealing with synthetic rubber and latices, and compounding ingredients, the products are arranged under main heads, with trade names, specific gravity, manufacturer and local distributor mentioned in separate columns. There are tables of the properties of hot, cold, oil-extended rubbers, carbon black masterbatches and butyl rubbers, as well as a composite table of general chemical constitution, oil resistance, useful temperature range and tensile properties of 16 elastomers.

The present edition has introduced a classified list of machinery, arranged in similar fashion to the compounding ingredients. Alphabetical indices of materials and machinery provide trade and chemical names, cross-reference to pages in the classified list, the number in the Swedish Customs Tariff (1956) under which a product comes. Full names and addresses, as well as "Code" names of Scandinavian and foreign suppliers appear in two separate indices; associations and organizations connected with the rubber industry in Sweden and abroad are mentioned, and also all Swedish rubber and cable manufacturers. Finally, various conversion tables useful to rubber technologists complete this informative and carefully compiled handbook.

"Chemical Engineering Catalog, 1956-57." Reinhold Publishing Corp., New York, N. Y. Cloth cover, 8½ by 11¼ inches, 1,932 pages. Price, $12.50.

This forty-first edition of the Catalog is made up of the illustrated brochures and catalogs of more than 550 manufacturers of chemical industry equipment, reporting specifications, performance data, suggestions for use, and all other information needed for the ordering of chemical equipment. Indices cover company names, trade names, applications or functional purposes, plants and specialized services, and manufacturers of pilot-plant equipment.

NEW PUBLICATIONS

"Piccolyte Resins." Bulletin #12-60-2-10-56, Harwick Standard Chemical Co., Akron, O. 4 pages. The properties, compatibility, and applications of Piccolyte coal-tar resins are reported in this technical bulletin.

"Lightning Selector for Users of Silicone Rubber Mechanical Goods." AD 24 E. General Electric Co., silicone products department, Waterford, N. Y. 4 pages. The major categories of the company's silicone compounds and typical properties of each appear on this chart. Also included are cross-references to AMS and ASTM specifications.

Publications of E. I. du Pont de Nemours & Co., Inc., elastomers division, Wilmington, Del.:

"Endor—a New Chemical Plasticizer." Report No. 56-5. Prepared by A. L. Moran. 12 pages. Endor, du Pont's new plasticizer for natural rubber and hot, cold, and extended types of SBR, is discussed in this booklet. An activated zinc salt of pentachlorothiophenol with an inert filler, it is odorless and non-toxic and is said to combine the best features of the RPA's. The effect of the plasticizer on physical properties and rate of cure of various natural and synthetic rubber stocks is reported, as well as compounding information and other pertinent technical data.

"NA-22—a Neoprene Accelerator." Report No. 56-6. Prepared by R. M. Murray. 16 pages. This accelerator for neoprene is said to produce a uniformly fast rate and high state of cure and does not stain or discolor on exposure to sunlight. Recipes for its use in Neoprene Type GN mechanical goods stocks and wire jacket stocks, and in Type W stocks, are given together with postcure data.

"Reinforcement of Philprene 1712 with Variable Quantities of Philblack I." Rubber Chemicals Bulletin No. 29. Phillips Chemical Co., Akron, O. 5 pages. Both tabulated and graphic test data on Philprene 1712 reinforced with variable quantities of Philblack I (ISAF) and Philblack O (HAF) are reported in this publication. Philblack I imparted higher modulus and better tensile strength than HAF black in oil-extended rubber. The hysteresis values of the two blacks were essentially equal. The oil-extended rubber compounds showed lower hysteresis values than conventional cold rubber stocks.

"2-Methyl-5-Ethyl Pyridine." Bulletin F-7621. Carbide & Carbon Chemicals Co., New York, N. Y. 6 pages. Physical properties and specifications of this intermediate for the vinyl pyridines used in the manufacture of certain synthetic rubbers and fibers are contained in this publication.

"Directory of National Trade Associations." Superintendent of Documents, United States Government Printing Office, Washington, D. C. Price, 40¢. This directory of more than 2,000 national trade associations and related organizations of businessmen gives the mailing address and the name and the title of the key executive in each organization. An index facilitates finding associations in particular product or service fields.

"33rd Annual Report—1955-56." American Management Association, New York, N. Y. 32 pages. The Association's activities during the past year are reviewed in this annual report to its members. In a foreword, Lawrence A. Appley, president of the group, says this country is facing the greatest shortage of trained management in its history.

"A Technology for the Analysis, Design, and Use of Textile Structures as Engineering Materials." By Walter J. Hamburger. American Society for Testing Materials, Philadelphia, Pa. 50 pages. Price, $1.50. The elastic behavior of textile materials in tension, compression, bending, and torsion; the effects of fiber properties and geometry upon yarn behavior; the effects of yarn properties and fabric geometry upon fabric behavior; and the importance of these behavior characteristics upon objective and subjective functional performance characteristics of textile structures are among the subjects considered in this reprint of the ASTM's 1955 Edgar Marburg Lecture.

"Bibliography on Reinforced Plastics." British Plastics Federation, London, England. Price, 1 guinea. This bibliography on reinforced plastics, compiled by the Federation, is now available with two supplements.

"Mystik Manual of Pressure-Sensitive Products." Mystik Adhesive Products, Inc., Chicago, Ill. Price, $2. Intended for designers, production engineers, purchasing agents, and materials-handling men, this illustrated handbook includes applications of pressure-sensitive tapes, a tape finder guide, and detailed descriptions of a wide variety of these tapes and industrial adhesives.

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Publications of Dow Corning Corp., Midland, Mich.:

"Dow Corning A-4004 Primer." Reference 4-610. 1 page. Properties and suggestions for use of this primer for improving the bond of Silastic S-2007 and A-4000 Adhesive to other materials are given in this issue of "Silastic Facts."

"Dow Corning Primers and Adhesives for Silastic." Reference 4-611. 2 pages. The use, curing, and other fabrication data on the company's primers and adhesives for Silastic are tabulated in this "Silastic Facts" issue.

"Silastic Fabricators." Reference 9-904. 4 pages. The names and addresses of firms in the United States fabricating parts made of the company's silicone rubber are listed by state in this publication. Canada, Great Britain, France, and Germany are also each represented by a single company.

Publications of Claremont Pigment Dispersion Corp., Roslyn Heights, L. I., N. Y.:

"The 'My' Series." Bulletin No. 411. 2 pages. Characteristics and recommendations for use of the company's complete ink system for gravure printing on Du Pont's Mylar film are discussed on these data sheets.

"The 'PE' Series." Technical Bulletin 220. 6 pages. The company's complete line of granular color concentrates for coloring polyethylene is discussed on these data sheets. Heat and light stability, migration and crocking, alkali resistance, and uses and methods of application of this "PE" Series are dealt with.

"The 'VC' Series." Bulletin No. 340. 2 pages. The company's gravure vinyl ink concentrates for printing on vinyl film and sheeting are listed and discussed on these data sheets.

"The 'MB' Series." Bulletin 345. 2 pages. Claremont's complete ink system for valley printing on treated polyethylene is the subject of this publication.

"Symposium on Rubber-to-Metal Bonding." SGF Publication No. 11. The Swedish Institution of Rubber Technology, Stockholm, Sweden. 104 pages. Price, 32 kronas. This is a collection of five papers read at the Spring, 1956, meeting of the Institution at Falsterbo, Sweden. They are: "The Principles of the Adhesion Phenomenon," by R. Houwink, Rubber-Stichting; "Die Gummi-Metallbindung unter besondere Berücksichtigung von Desmodur R," by F. von Spulak, Farbenfabriken Bayer; "Evaluation of Rubber-to-Metal Bonds," by J. M. Buist, T. J. Meyrick, and R. L. Stafford, ICI; "Effective Approaches to the Evaluation of Rubber-to-Metal Bonding Agents," by H. H. Irvin, Marbon Chemical Division; and "Rubber-to-Metal Bonding in the United States—a Review of Current Practices," by S. L. Brams, Dayton Chemical Product Laboratory, Inc.

"Hycar Latex Newsletter." No. 14, September, 1956. B. F. Goodrich Chemical Co., Cleveland, O. 8 pages. This issue contains a technical discussion of Hycar 1852, an improved pigment binding latex for the paper coating industry, and data on the effects of Hycar 1562 latex on the physical properties of paper.

"National Basic Materials Properties Comparator Chart." National Vulcanized Fibre Co., Wilmington, Del. This chart tabulates the electrical, mechanical, physical, chemical, fabrication, and general properties of the company's laminated plastic and vulcanized fiber. Materials are rated as excellent, good, fair, and poor, and comparative prices are given.

"Thermogrip Adhesives and Applying Devices." United Shoe Machinery Corp., industrial sales division, Boston, Mass. 4 pages. The advantages of the company's new coiled form of thermoplastic adhesive to be used with its Model A Thermogrip applicator are discussed in this illustrated brochure.

"Georgia Kaolin Handbook." Georgia Kaolin Co., Elizabeth, N. J. A loose-leaf binder containing the first four of a series of technical bulletins on the mineral kaolin (china clay) is being made available by the company. Included among the four bulletins are Bulletin 1, "A Visit to Georgia Kaolin Company"; Bulletin 2, "Progress through Georgia Kaolin Research"; and Bulletin 4, "Hydrite Kaolinites in Reinforced Plastics." All the publications are heavily illustrated.

Publications of the Office of Technical Services, United States Department of Commerce, Washington, D. C.:

"Adhesives." CTR-300. Price, 25¢. Available government technical reports on adhesives, totaling 478, are listed in this catalog.

"Rubber." CTR-321. Price, 10¢. This new catalog of government technical reports available to industry on rubber lists 193 items, including German papers captured by the Allies during World War II.

"Collection of Papers Presented at the Colloquim in Statistical Design of Laboratory Experiments." PB 121181. 102 pages. Price, $2.75. Originally a series of lectures presented by civilian statisticians during a colloquim conducted at the Naval Ordnance Laboratory in 1954, this volume contains viewpoints useful to the engineer or scientist concerned with designing experiments and evaluating the significance of resulting data.

"Testing of Silicone Rubber at Elevated Temperatures." PB 121192. 41 pages. Price, $1.25. This report by A. J. De Francesco, Connecticut Hard Rubber Co., for Wright Air Development Center, anticipates a future need in supersonic aircraft of elastomeric compounds that will perform effectively at high temperatures. An apparatus to measure the physical properties of silicone rubber in temperatures up to 400° F. was designed and constructed. The report compares the tensile strength, elongation, and tear strength at room temperature, 212° F., and 400° F. for 15 commercial silicone compounds.

"Room-Temperature-Vulcanizing Silicone Adhesive." PB 121209. 69 pages. Price, $1.75. In this report Mr. De Francesco describes a search for a new method or adhesive which would bond silicone rubber to aircraft metals and to itself without the use of heat and pressure. All commercially available adhesives recommended for the purpose are evaluated. Other room-temperature-curing systems with various modified siloxanes were studied. The use of several curing systems developed during the research to bond silicone rubber to aluminum and to itself is described. Also included is a literature survey.

"Development of Chemically Resistant, High-Temperature Protective Fabric." PB 121212. 88 pages. Price, $2.25. A. S. Kidwell, Connecticut Hard Rubber Co., developed for Wright Air Development Center a coated fabric of aluminum-pigmented polychlorotrifluoroethylene (polyfluoron) on glass fabric with a low-density silicone rubber sponge to protect personnel from brief exposure to chemical fires at temperatures up to 1,000° F. The fabric is flexible and useful over a temperature range of –80 to 390° F. The fabric was non-porous to 1,000° F. steam and was not penetrated by reaction products of ethyl aniline-fuming nitric acid combustion.

"Elastomer Research and Development." Vol. 1, PB 121360, 152 pages, price $2.50; and Vol. 2, PB 121361, 314 pages, price $5.50. These two volumes consist of 64 reports on military research presented at the fourth Army-Navy-Air Force Conference on Elastomer Research and Development in January, 1956. The papers describe specific work with elastomers in the general areas of selection and improvement of materials, evaluation of new materials from industry, and, in particular, invention and discovery of new materials to meet extreme operational conditions.

"Vinylfoam Newsletter." Elastomer Chemical Corp., Newark, N. J. 4 pages. The physical properties and advantages of the company's Vinylfoam are contained in this publication. Recent applications of Vinylfoam in the railroad and furniture industries are also cited.

"Humidification for Industry." Bulletin No. 492. Abbeon Supply Co., Jamaica, N. Y. 4 pages. The necessity of humidity control in industry is discussed in this publication. The company's instruments and equipment for this purpose are described.

"Physical Properties of Carbide and Carbon Chemicals." Carbide & Carbon Chemicals Co., New York, N. Y. 24 pages. The physical properties and applications of more than 330 of the company's organic chemicals are reported in this 1957 edition of the booklet. Twenty-one new products are included.

"Texrope Grommet V-Belts." Bulletin 20B6497C. Allis-Chalmers Mfg. Co., Milwaukee, Wis. 4 pages. The company's Grommet V-belts are described and illustrated. The belts represent a joint developmental effort of Allis-Chalmers and The B. F. Goodrich Co.

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MARKET REVIEWS

Natural Rubber

Both prices and volume of trading increased abruptly on the natural rubber market during the October 16-November 15 period as armed conflict exploded in the Middle East. Trading on the New York Commodity Exchange in all three contracts jumped from the previous-period total of 17,190 tons to 45,130 tons. RSS 1 moved from 32¢ a pound to 35.38¢ within a six-day trading period.

The rise began with riots in Singapore and talk of a possible dock strike on the East and Gulf coasts of the United States. The rise continued with the outbreak of the Israeli-Egyptian war and the Anglo-French attack on Egyptian Suez Canal positions. The invasion of Hungary strengthened the upward trend. The breaking off of the Middle East wars eased prices somewhat.

Since the situation is still uncertain, the market remains sensitive to political developments. Prices are expected to remain at the current higher levels. The spreading dock strike now paralyzing the nation's major ports should provide pressures for even higher price levels. Countering this, but in long-range terms, is the GSA's decision to make available to industry more than its present 7,500 tons a month of natural rubber from its rotating stockpile.

Statistically, week-end closing Commodity Exchange future prices for all three rubber contracts were as follows:

RSS #1 Contract

	Sept. 21	Oct. 19	Oct. 26	Nov. 2	Nov. 9
Sept.	32.00				
Dec.	32.40	32.80	34.40	34.55	34.90
Total weekly sales, tons	1,620	110	490	1,420	830

Rubber Standard Contract

	Sept. 21	Oct. 19	Oct. 26	Nov. 2	Nov. 9
Sept.	31.70				
Dec.	31.75	32.25	34.15	34.30	34.65
Mar.	31.05	31.65	32.65	33.45	34.00
May	34.45	31.40	32.25	33.00	33.60
July	30.15	30.85	31.80	32.30	33.20
Sept.	29.55	30.65	31.45	31.65	32.75
Nov.		30.15	30.95	31.15	32.25
Total weekly sales, tons	720	30	30	170	270

Rex Contract

	Sept. 21	Oct. 19	Oct. 26	Nov. 2	Nov. 9
Sept.	31.80				
Nov.	32.10	32.20	34.00	34.50	34.60
Jan.	31.70	31.94	33.18	33.80	34.40
Mar.	31.10	31.75	32.75	33.55	34.25
May	30.50	31.40	32.35	33.10	33.80
July	30.10	30.85	31.90	32.40	33.40
Sept.	29.60	30.65	31.45	31.75	32.95
Nov.		30.15	30.95	31.25	32.45
Total weekly sales, tons	5,500	3,390	6,650	14,370	9,550

On the physical market, RSS #1 began the September 16-October 15 period at 32.13¢, climbed to a period-high of 35.38¢ on October 31, and ended the period at 34.75¢. Average October monthly sellers' prices for representative grades (as reported by the Rubber Trade Association of New York) were as follows: RSS #1, 32.53¢; RSS #3, 32.14¢; #3 Amber Blankets, 27.45¢; and Flat Bark, 21.01¢. There were 22 trading days during the month. For the first half of November, the #1 grade averaged 34.42¢.

New York Physical Market
Week-end Closing Prices

	Sept. 21	Oct. 19	Oct. 26	Nov. 2	Nov. 9
RSS #1	32.50	32.00	33.25	34.00	34.25
2	32.25	31.75	33.00	33.75	34.00
3	31.75	31.63	32.75	33.50	33.88
Pale Crepe #1 Thick	44.00	42.00	43.00	43.25	43.25
Thin	43.00	42.00	43.00	43.25	43.25
#3 Amber Blankets	26.50	26.00	26.50	27.50	28.00
Thin Brown Crepe	25.50	25.50	26.00	27.00	27.25
Standard Flat Bark	20.50	20.75	21.25	22.00	22.50

Synthetic Rubber

Consumption of all types of synthetic rubber during October totaled 81,507 long tons, as compared with September's consumption of 68,492 long tons, according to the latest available statistics supplied by The Rubber Manufacturers Association, Inc. Of the total new rubber consumed during October, synthetic rubber accounted for 61.36%, slightly better than the September ratio of 61.09%. Production of all types of synthetic rubber within the United States during October, however, fell somewhat to 88,083 long tons from the 90,602 long tons produced during September. The higher consumption during October dropped the stock level from 199,262 long tons recorded at the end of September to 194,067 long tons at the end of October.

As was to be expected, foreign demand for American synthetic rubber increased during November as a result of the blocking of the Suez Canal. These higher levels are certain to continue for the next several months. Trade sources even venture the opinion that the increased demand may continue after the Canal has been cleared, since conditions in the Near East are sure to remain unsettled.

Estimated consumption of natural and synthetic rubber in the United States during the first 10 months of 1956 is 1,204,742 long tons, according to the RMA. This figure is an encouraging one, especially in comparison with the 10-month 1955 record consumption year figure of about 1,270,850 tons. The total for the year, however, is not expected to exceed the all-time high recorded for 1955.

Industry sources report that demand for carbon black masterbatches continues to fall. On the other hand, non-staining oil masterbatches, so far represented on the market by a single manufacturer, are due for an upsweep. Several producers are expected to announce such masterbatches during 1957.

Latex

Buying interest revived considerably in both the natural and synthetic rubber latex markets during the October 16-November 15 period, according to industry reports. The most important factor was political developments in the Middle East and elsewhere, arousing the anxiety of consumers to build up stocks from both near and far shipments. Natural rubber latices were seen to be particularly in demand because the prospect of lower price levels was now believed to be remote. The increased demand relieved the pressure of supplies in the Far East and was said to have brought about some improvement in the premium for both drum and bulk latex. A far from negligible factor in the higher levels of trading for all latices was climbing automotive production in the United States.

Prices for ASTM Centrifuged Concentrated natural latex, in tank-car quantities, f.o.b. rail tank cars, ranged during the period from 41 to 45¢ per pound solids. Prices of synthetic latices remained the same, being quoted as SBR, 26-32.3¢; neoprene, 37.47¢; and N-type, 46-54¢ a pound.

Final August and preliminary September domestic statistics for all latices were reported by the United States Department of Commerce as follows:

(All Figures in Long Tons, Dry Weight)

Type of Latex	Production	Imports	Consumption	Month-End Stocks
Natural				
Aug.	0	4,715	6,374	18,099
Sept.	0		5,820	14,944
SBR				
Aug.	4,867	35	5,055	6,402
Sept.	5,651		4,572	6,340
Neoprene				
Aug.	882	0	816	1,076
Sept.	1,180	0	685	1,269
Nitrile				
Aug.	684	0	698	1,703
Sept.	938	0	494	1,057

Reclaimed Rubber

A definite increase in the demand for reclaimed rubber during the October 16-November 15 period was noted by trade sources. This fulfilled last month's expectations that production of the 1957 automobile models would provide a fillip to the reclaimed rubber industry. Continuation of the rejuvenated activity was anticipated for the last two weeks of November and well into December.

Prices of reclaimed rubber during the period were unchanged.

RECLAIMED RUBBER PRICES

	Lb.
Whole tire: first line	$0.105
Fourth line	.0925
Inner tube: black	.15
Red	.21
Butyl	.14
Pure gum, light colored	.23
Mechanical, light colored	.135

The above list includes those items or classes only that determine the price basis of all derivative reclaim grades. Every manufacturer produces a variety of special reclaims in each general group separately featuring characteristic properties of quality, workability, and gravity at special prices.

Scrap Rubber

Dull trading characterized the scrap rubber market during the October 16-November 15 period, according to trade sources. The situation was a disappointment to dealers who had anticipated greater demand by the automotive industry. Highlighting the sluggish period was a November shipment of mixed auto tires to Naugatuck.

Scrap rubber import and export figures for July had not been made available by the Bureau of the Census at the time of this writing.

Auto tube prices rose fractionally during the period. Prices of other scrap rubber grades were unchanged. Period-end prices were as follows:

	Eastern Points	Akron, O.
	(Per Net Ton)	
Mixed auto tires	$10.00/13.50	$13.50/14.00
S.A.G. auto tires	Nom.	Nom.
Truck tires	Nom.	Nom.
Peelings, No. 1	40.00	40.00
2	Nom.	Nom.
3	16.00	17.00
Tire buffing	Nom.	Nom.
	(¢ per Lb.)	
Auto tubes, mixed	2.75	2.75
Black	5.75	5.75
Butyl	3.75	3.75
Red	6.75	6.75

Rayon

Four producers of high-tenacity rayon yarn reduced their prices by 3¢ a pound, effective November 1. They are American Enka Corp., American Viscose Corp., E. I. du Pont de Nemours & Co., Inc. (super high-tenacity yarn only), and Industrial Rayon Corp. The new price of 1650 denier regular high-tenacity yarn is 55¢ a pound. The price of super high-tenacity yarn is now 58¢ a pound.

On November 9, Beaunit Mills, Inc., announced an increase in its regular high-tenacity yarn from 51¢ to 55¢ a pound, as well as an increase in the super high-tenacity yarn from 54¢ to 58¢ a pound. The former prices had been in effect since July 1.

Total calculated production of rayon and acetate yarn during October was 61,700,000 pounds, of which 31,700,000 pounds were regular-tenacity yarn and 30,000,000 pounds were high-tenacity rayon yarn. September production had been: total, 53,100,000 pounds; regular-tenacity, 26,700,000 pounds; and high-tenacity, 26,400,000 pounds.

Total domestic shipments for October were 62,800,000 pounds, consisting of 33,600,000 pounds of regular-tenacity yarn and 29,200,000 pounds of high-tenacity rayon yarn. September shipments had been: total, 55,300,000 pounds; regular-tenacity, 26,700,000 pounds; and high-tenacity, 28,600,000 pounds.

Total end-of-October stocks were 61,300,000 pounds, of which 49,000,000 pounds were regular-tenacity yarn and 12,300,000 pounds were high-tenacity rayon yarn. End-of-September stocks had been: total, 63,700,000 pounds; regular-tenacity, 51,500,000 pounds; and high-tenacity, 12,200,000 pounds.

Current prices of tire yarns and fabrics follow:

RAYON PRICES

Tire Yarns

High-Tenacity	
1100/ 480	$0.59/ $0.64
1100/ 490	.59/ .64
1150/ 490	.64
1165/ 480	.65
1230/ 490	.64
1650/ 720	.55/ .61
1650/ 980	.55/ .61
1875/ 980	.61
2200/ 960	.55/ .60
2200/ 980	.55/ .60
2200/1466	.64
4400/2934	.60
Super-High-Tenacity	
1650/ 720	.58
1900/ 720	.58

Tire Fabrics

1100/490/2	.77
1650/980/2	.725
2200/980/2	.715

Industrial Fabrics

Interest in wide industrial goods and cotton ducks continued during the October 16-November 15 period, although active buying was still relatively limited. Most sales took place for nearby delivery. Behind the interest in wide industrial goods and cotton ducks were reports of good business in a number of fields where sizable yardages of heavy goods are used. Automotive production was said to be continuing at a lively pace, with one large company adding a sixth day to its production schedule. Many cotton fabrics trade sources anticipated heavier purchases during the last half of November and into December.

Period-end prices of cotton fabrics were:

INDUSTRIAL FABRICS

Drills

59-inch 1.85 yd.	*yd.*	$0.375
2.25-yd		.325

Ducks

38-inch 1.78-yd. S.F.	*yd.*	nom.
2.00-yd. D.F.		nom.
51.5-inch, 1.35-yd. S.F.		nom.
Hose and belting		.69

Osnaburgs

40-inch 2.11-yd.	*yd.*	.255
3.65-yd.		.1625

Raincoat Fabrics

Printcloth, 38½-in., 64x60, 5.35-yd.	*yd.*	$0.1425
6.25 yd.		.12
Sheeting, 48-inch, 4.17-yd.		.20
52-inch, 3.85-yd.		.23

Chafer Fabrics

14.40-oz./sq. yd. Pl.	*yd.*	.73
11.65-oz./sq. yd. S.		.64
10.80-oz./sq. yd. S.		.6875
8.9-oz./sq. yd. S.		.70

Other Fabrics

Headlining, 59-in., 1.65-yd., 2-ply	*yd.*	.41
64-inch, 1.25-yd., 2-ply		.59
Sateens, 53-inch, 1.32-yd.		.575
58-inch, 1.21-yd.		.625

Financial

(*Continued from page 463*)

Thermoid Co., Trenton, N. J., and subsidiaries (excluding minority interest). Three quarters ended September 30, 1956; net income, $1,318,599, equal to $1.50 a common share, compared with $1,085,938, or $1.20 a share, a year earlier; gross sales, $30,573,518, against $28,333,957.

Struthers Wells Corp., Warren, Pa. Nine months to August 31, 1956: net income, $627,718, equal to $2.02 a share, contrasted with $191,039, or 41¢ a share, in the 1955 period.

Union Carbide & Carbon Corp., New York, N. Y. First three quarters, 1956: net income, $102,247,624, equal to $3.50 a share, against $101,436,489, or $3.48 a share, in last year's quarters; sales, $937,129,856, against $857,123,236.

United Carbon Co., Charleston, W. Va., and subsidiaries. First nine months, 1956: net profit, $4,438,695, equal to $3.72 a capital share, compared with $4,014,722, or $3.36 a share, in the 1955 months; net sales, $44,929,686, against $33,266,317.

United States Rubber Co., New York, N. Y., and subsidiaries. Nine months ended September 30, 1956: net profit, $23,453,685, equal to $3.61 a common share, compared with $22,290,861, or $3.40 a share, in the same months the year before; net sales, $675,147,998, against $688,775,620.

Westinghouse Air Brake Co., Wilmerding, Pa. First nine months, 1956: net income, $9,222,580, equal to $2.21 a share, contrasted with $5,009,469, or $1.21 a share, in the 1955 months.

Westinghouse Electric Corp., Pittsburgh, Pa. First three quarters, 1956: net loss, $1,399,000, contrasted with net profit of $43,839,000, equal to $2.55 a share, in the same months the year before.

S. S. White Dental Mfg. Co., Philadelphia, Pa., and domestic and Canadian subsidiaries. January 1-September 30, 1956: net income, $563,177, equal to $1.53 a capital share, against $631,534, or $1.72 a share, a year earlier; net sales, $16,771,162, against $16,501,456.

Are you measuring all the muscles in your base fabrics?

Fabric breaking strength is frequently given too much importance, when it is just one of at least seven kinds of strength that contribute to end-product performance!

Over-emphasis on one kind of strength can give a misleading picture of how a fabric-reinforced plastic or rubber product will behave. Depending on end use, the impact, shear, flex, tear, burst or stitch strength can be just as decisive as breaking strength. All together, they permit a much more dependable estimate of product capabilities.

When your base fabric is one of the many provided by Wellington Sears for coating, laminating, combining and rubberizing, you know that its strength *and all other properties* have been considered in the light of your specific need. And moreover you know that a century of experience is working for you, to anticipate and help solve your working-fabric problems.

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STATISTICS of the RUBBER INDUSTRY

U.S.A. Imports and Production of Natural (Including Latex and Guayule) and Synthetic Rubber (in Long Tons)

Year	Natural	GR-S	SBR-Types	Butyl	Neoprene	N-Type	Total Natural and Synthetic
1949	**660,792**	**288,882**	**21,717**	**54,046**	**35,215**	**11,072**	**1,071,724**
1950	**802,249**	**350,801**	**28,086**	**60,915**	**50,067**	**12,037**	**1,304,155**
1951	**733,048**	**694,583**	**9,946**	**76,475**	**58,907**	**15,333**	**1,588,292**
1952	**805,997**	**636,969**	**17,885**	**81,630**	**65,745**	**16,228**	**1,624,454**
1953	**647,615**	**668,386**	**12,342**	**79,801**	**80,495**	**20,198**	**1,508,837**
1954	**596,848**	**472,698**	**17,707**	**58,802**	**69,150**	**21,396**	**1,236,601**
1955							
Jan.	**49,941**	**57,607**	**1,436**	3,220	6,983	2,215	121,402
Feb.	**50,880**	**55,293**	**1,149**	3,727	6,910	1,659	119,618
Mar.	**61,250**	63,940	**1,229**	5,256	7,132	2,409	141,216
Apr.	**61,113**	**50,745**	**10,081**	5,148	8,359	2,433	137,879
May	61,042	3,592	63,220	5,115	7,852	2,720	143,541
June	52,762	3,739	61,717	3,872	5,919	3,422	131,431
July	43,626	1,640	64,910	5,395	6,904	3,195	125,670
Aug.	59,840	....	68,898	4,203	8,511	2,792	144,244
Sept.	50,459	....	68,228	5,097	7,677	2,821	134,282
Oct.	45,720	....	73,103	5,501	8,118	2,958	135,400
Nov.	50,509	....	75,745	4,935	8,537	2,931	142,657
Dec.	48,032	....	74,813	4,710	8,455	3,068	139,078
Total	635,174	236,556	564,589	56,179	91,357	32,623	1,616,478
1956							
Jan.	58,803	....	76,028	6,896	8,207	3,055	152,989
Feb.	53,353	....	73,457	6,229	8,560	2,879	144,478
Mar.	52,749	....	77,812	5,686	7,822	3,607	147,676
Apr.	51,394	....	74,502	5,685	8,481	3,621	143,683
May	39,789	....	78,309	5,647	7,795	2,873	134,413
June	36,694	....	69,820	4,638	8,929	2,321	122,402
July	41,195	....	70,483	7,181	7,935	2,432	129,226
Aug.	40,367	....	69,545	7,052	7,769	2,102	126,835
Sept.*	....	....	72,778	7,219	8,328	2,277	.....

* Preliminary.
Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.

U.S.A. Consumption of Natural (Including Latex) and Synthetic Rubber (Long Tons)

Year	Natural	GR-S	SBR-Types	Butyl	Neoprene	N-Type	Total Natural and Synthetic
1949	**574,522**	**299,420**	**21,717**	**52,664**	**31,753**	**8,827**	**988,903**
1950	**720,268**	**388,427**	**27,803**	**66,348**	**43,781**	**11,930**	**1,258,557**
1951	**454,015**	**617,200**	**9,244**	**70,500**	**48,887**	**13,066**	**1,212,912**
1952	**453,846**	**648,816**	**17,604**	**71,229**	**55,522**	**13,866**	**1,260,883**
1953	**553,473**	**611,748**	**12,433**	**77,826**	**65,900**	**16,929**	**1,338,309**
1954	596,285	483,001	17,344	61,464	57,203	17,715	1,233,412
1955							
Jan.	56,911	54,728	1,643	4,478	5,676	1,931	125,367
Feb.	50,997	54,707	1,293	4,312	5,476	1,921	118,706
Mar.	**58,472**	**62,548**	**1,189**	4,839	6,423	2,174	135,645
Apr.	**52,963**	**54,091**	**5,655**	4,321	5,884	2,172	125,086
May	54,746	2,533	60,325	4,455	6,143	1,965	130,167
June	56,282	3,666	62,226	4,704	6,320	2,581	135,779
July	46,166	2,690	50,398	3,894	4,294	1,621	109,063
Aug.	48,359	....	59,746	4,307	6,450	2,219	121,268
Sept.	50,963	....	63,330	4,578	6,197	2,270	127,338
Oct.	54,995	....	66,744	4,739	6,626	2,280	135,374
Nov.	52,769	....	68,111	4,420	6,896	2,234	134,430
Dec.	48,377	....	63,149	4,219	6,491	2,167	124,403
Yr.-end adj.	+2,800	....	+3,225	+725	.....	+500	+7,250
Total	634,800	234,963	507,034	53,991	72,876	26,035	1,529,699
1956							
Jan.	53,751	....	65,375	4,223	6,684	2,198	132,231
Feb.	50,285	....	62,366	4,155	6,430	2,289	125,525
Mar.	50,040	....	64,458	4,515	6,542	2,373	127,928
Apr.	47,446	....	62,179	4,228	6,125	2,150	122,128
May	48,342	....	63,629	4,285	6,379	2,103	124,738
June	43,638	....	56,390	4,026	5,536	1,864	111,454
July	38,353	....	48,907	3,316	4,435	1,538	96,549
Aug.	46,700	....	59,756	4,102	6,554	2,125	119,237
Sept.*	43,623	....	56,488	4,005	5,990	2,009	112,115

* Preliminary.
Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.

"Locked in the Versene claw"—that's the fate of metal ions when they encounter chelation. They become trapped within the inner ring structure of a newly formed compound where they remain unless reverse action is desired. This phrase is taking on new meaning for the rubber industry as the chemistry of chelation is reviewed.

The Chemistry of Chelation: Part IV

Applications in the rubber industry · Prolonging polymerization Inhibiting action · In latexes · Rubber-coated fabrics · A new kind of chemistry?

As has been discussed previously, the Versene® series and Versenol® series chelating agents will inactivate practically all metal ions they contact in solution. The pH factor of the solution or of the finished product influences the choice of agent. To control iron in caustic solutions, look to Versene T®; in alkaline solutions—Versene Fe-3 Specific®; in acid—the Versene series. Or if solutions drift from one pH value to another, an effective Versene combination can be devised to completely complex metal ions present. However, when it is desirable, the claw-like holding power of chelation can be reversed. In polymerization reactions, for example, ferrous iron ions may be released gradually at a predetermined rate. This property is utilized in manufacturing synthetic rubber.

PROLONGING POLYMERIZATION

Erratic polymerization has been a costly bottleneck in the production of synthetic rubber. In the past, reactions would die out before desired conversion took place. Uniform viscosity of the polymer was difficult to maintain. Production delays and poor product uniformity frequently resulted. To correct these problems, pyrophosphates and hydroperoxides proved a step in the right direction . . . but still fell short of being satisfactory. Further study revealed that the final answer lay in organic chelating agents . . . that a reproducible Redox catalyst activation system can be obtained using Versene Fe-3 alone or with pyrophosphate.

A blend of ethylenediaminetetraacetic acid tetra sodium salt and N,N'-di-(2-hydroxyethyl) glycene sodium salt —Versene Fe-3 has proved adequate at less than 1/100 of a part per 100 parts of monomer charged. The complexing action of Versene Fe-3 locks large reservoirs of ferrous ions in solution and releases them gradually, allowing polymerization to continue at a controlled rate. Results: Production delays are reduced to a minimum; plant operations smooth out; product non-uniformities practically disappear.

INHIBITING ACTION

Research has shown chelation to be helpful in other areas of rubber manufacture—notably where copper and manganese cause an embrittlement problem. High costs and discoloring characteristics have been the drawbacks of commonly used inhibitors. But with Versene as the inhibitor, excellent results have been obtained. Versene holds the copper and manganese ions inactive and prevents discoloration from occurring.

IN LATEXES

In latexes, the use of Versene products as stabilizers prevents decomposition, coagulation, sludge formation, and putrefaction where such conditions are caused by metal ion contaminations. Inhibiting action lasts until the latex is coagulated or used for dipping. And if sludge is already precipitated, the Versene resuspends it by complexing the divalent metal compounds that caused the sludge in the first place.

It should be mentioned that wherever proteins, fats, and soaps are present—and metal contamination introduces a problem— chelation may be the answer. In many cases, Versene or Versenol alone is sufficient. But if iron is present along with other divalent metals, or iron alone presents the major problem, the use of Versene Fe-3 Specific or combinations of Versene Fe-3 Specific with Versene or Versenol may be practical.

RUBBER-COATED FABRICS

Difficulties arising in rubberizing fabrics are almost invariably due to traces of copper or manganese in the cloth. Enough contamination to cause trouble can result from passing the cloth over brass guide bars or by using equipment made of copper-bearing alloys.

Such cloth can be decontaminated by rinsing with a hot, dilute Versene solution.

A NEW KIND OF CHEMISTRY?

Is chelation the answer to all ion contamination difficulties? Despite its many successful applications, the answer is sometimes "no". For, remarkable as it is—in locking up metal ions to improve production and product quality—chelation does not solve all problems in every application. But wherever metal ions do pose a problem, investigation is worthwhile. And we'll help in every possible way. To see if you can put the Versene or Versenol products to profitable use, write Technical Service and Development, Dept. SC 911N-1, THE DOW CHEMICAL COMPANY, Midland, Michigan.

you can depend on DOW CHEMICALS

DOW

U.S.A. Stocks of Synthetic Rubber

(Long Tons)

Year	SBR-Types	Butyl	Neoprene	N-Type	Total
1946	83,090	19,478	10,470	3,755	116,793
1947	40,606	13,184	5,237	3,339	62,366
1948	96,304	10,995	5,072	2,762	115,133
1949	77,743	12,224	4,654	3,433	98,054
1950	36,942	7,243	5,733	2,840	52,758
1951	105,271	12,481	8,379	3,821	129,952
1952	83,861	22,716	8,535	3,875	118,987
1953	135,153	24,866	11,480	4,346	175,845
1954	115,499	19,267	11,349	4,280	150,395
1955					
Jan.	114,976	17,079	11,598	4,121	147,774
Feb.	111,796	15,424	10,555	3,888	141,663
Mar.	113,594	15,096	11,037	3,860	143,587
Apr.	112,156	14,813	10,863	3,612	141,444
May	109,381	14,449	10,283	3,995	138,108
June	103,844	13,053	9,755	4,042	130,694
July	110,281	13,288	11,213	5,120	139,902
Aug.	108,211	12,395	11,326	5,118	137,050
Sept.	107,641	12,190	11,209	4,995	136,035
Oct.	105,746	12,146	11,820	5,041	134,753
Nov.	105,287	11,646	11,530	5,201	133,664
Dec.	108,339	10,180	12,220	5,580	136,319
Yr.-end adj.	+650	+320	.....	+450	+1,420
	108,989	10,500	12,220	6,030	137,739
1956					
Jan.	111,263	12,303	11,850	6,316	141,732
Feb.	114,389	13,027	11,888	6,602	145,906
Mar.	118,063	13,458	12,037	7,437	150,995
Apr.	121,054	14,071	12,042	8,243	155,370
May	127,163	15,253	11,478	8,788	162,682
June	133,570	15,744	12,927	8,955	171,196
July	145,601	18,899	15,084	9,229	188,813
Aug.	148,176	21,267	14,540	8,503	192,486
Sept.*	153,910	23,268	13,843	7,990	199,011

Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.
* Preliminary.

U.S.A. Stocks of Latex

(Long Tons, Dry Weight)

Year	Natural	GR-S*	Neoprene	N-Type	Total Synthetic	Total Natural & Synthetic
1946	4,865	....	....	....	....	4,865
1947	5,033	....	....	....	....	5,033
1948	11,235	....	....	....	....	11,235
1949	5,063	....	....	....	....	5,063
1950	4,927	....	....	....	....	4,927
1951	4,752	3,727	1,245	532	5,504	10,256
1952	6,201	5,040	1,019	902	6,961	13,162
1953	13,532	4,794	1,117	721	6,632	20,164
1954	11,133	5,134	1,087	811	7,032	18,165
1955						
Jan.	9,684	5,861	1,067	812	7,740	17,424
Feb.	8,619	5,753	879	692	7,324	15,943
Mar.	7,820	6,940	909	658	8,507	16,327
Apr.	6,790	7,098	786	725	8,609	15,399
May	8,854	7,021	767	842	8,630	17,484
June	9,788	6,645	817	958	8,420	18,208
July	11,934	6,950	850	1,155	8,955	20,889
Aug.	11,962	6,201	885	1,076	8,162	20,124
Sept.	12,595	6,448	975	1,296	8,719	21,314
Oct.	12,156	5,798	1,075	1,196	8,069	20,225
Nov.	12,616	6,307	1,089	1,174	8,570	21,186
Dec.	12,628	6,480	1,236	1,282	8,998	21,626
Yr.-end adj.	+575	+500	....	+525	+1,025	+1,600
	13,203	6,980	1,236	1,807	10,023	23,226
1956						
Jan.	16,059	6,522	1,093	1,906	9,521	25,580
Feb.	16,735	7,011	1,162	1,943	10,116	26,851
Mar.	18,309	6,867	1,097	2,340	10,304	28,613
Apr.	21,384	7,415	1,163	2,272	10,850	32,234
May	21,234	7,516	1,218	2,194	10,928	32,162
June	21,033	7,447	1,328	2,086	10,861	31,894
July	19,952	7,288	1,109	2,009	10,406	30,358
Aug.	18,099	6,402	1,076	1,703	9,181	27,280
Sept.†	14,944	6,340	1,269	1,057	8,666	23,610

Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.
* Includes SBR-Types.
† Preliminary.

U.S.A. Imports and Production of Natural and Synthetic Latices

(Long Tons, Dry Weight)

Year	Natural	GR-S*	Neoprene	N-Type	Total Synthetic	Total Natural & Synthetic
1946	8,012	24,810	13,595	....	38,405	46,417
1947	17,675	22,474	6,089	....	28,563	46,238
1948	32,630	21,494	5,022	....	26,516	59,146
1949	29,974	21,357	3,651	....	25,008	54,982
1950	54,401	31,339	5,725	....	37,064	91,465
1951	54,963	32,972	6,866	2,948	42,786	97,749
1952	48,228	42,273	7,598	4,164	54,035	102,263
1953	75,511	48,112	9,026	5,844	62,982	138,493
1954	74,483	48,379	8,214	6,866	63,459	137,942
1955						
Jan.	7,853	6,199	617	708	7,524	15,377
Feb.	6,110	5,634	797	525	6,956	13,066
Mar.	7,611	7,078	854	738	8,670	16,281
Apr.	8,550	5,680	975	972	7,627	16,177
May	8,849	5,337	880	815	7,032	15,881
June	7,736	4,777	905	1,450	7,132	14,868
July	8,702	4,800	641	951	6,392	15,094
Aug.	8,885	4,519	881	1,010	6,410	15,295
Sept.	8,109	5,769	994	1,091	7,854	15,963
Oct.	6,900	6,231	922	883	8,036	14,936
Nov.	7,085	6,933	1,004	781	8,718	15,803
Dec.	6,364	6,407	962	874	8,243	14,607
Total	92,754	69,364	10,432	10,798	90,594	183,348
1956						
Jan.	10,328	6,885	848	919	8,652	18,980
Feb.	7,965	6,943	930	827	8,700	16,665
Mar.	7,800	5,911	782	1,158	7,851	15,651
Apr.	6,995	6,097	969	866	7,922	14,917
May	5,731	4,966	939	614	6,519	12,250
June	5,006	4,776	907	543	6,226	11,232
July	3,522	4,241	444	731	5,416	8,938
Aug.	4,715	4,902	882	684	6,468	11,183
Sept.†	....	....	1,180	938	....	....

Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.
* Includes SBR-Types.
† Preliminary.

U.S.A. New Supply, Consumption, Exports, and Stock of Reclaimed Rubber

(Long Tons)

Year	New Supply	Consumption	Exports	Stocks
1946	295,612	275,410	14,461	33,666
1947	291,395	288,395	14,556	35,943
1948	266,861	261,113	11,428	32,630
1949	224,029	222,679	10,367	28,263
1950	314,008	303,733	11,740	35,708
1951	366,700	346,121	14,722	45,082
1952	274,981	280,002	11,180	30,664
1953	298,336	285,050	11,397	32,319
1954	258,101	249,049	10,232	30,746
1955				
Jan.	25,336	25,322	1,041	29,656
Feb.	25,444	24,333	1,085	30,125
Mar.	29,574	28,674	1,088	30,311
Apr.	26,817	26,609	1,088	30,068
May	27,911	27,652	1,056	29,528
June	30,451	29,157	1,128	29,725
July	24,114	22,563	1,176	29,939
Aug.	25,223	25,790	1,144	27,956
Sept.	26,512	26,340	1,018	27,110
Oct.	28,038	26,597	1,381	27,565
Nov.	29,124	27,229	1,313	28,473
Dec.	28,105	24,515	1,470	31,058
Year.-end adj.	.....	—2,000	.....	+440
Total	326,649	312,781	13,988	31,498
1956				
Jan.	26,205	25,827	1,382	31,640
Feb.	27,108	25,571	1,115	31,875
Mar.	28,468	26,176	1,163	33,326
Apr.	26,933	23,999	1,179	34,360
May	25,485	23,560	1,297	34,863
June	22,153	20,560	1,264	35,647
July	19,776	18,099	952	35,703
Aug.	21,724	21,498	1,076	35,512
Sept.*	21,946	20,012	....	36,067

Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.
* Preliminary.

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U.S.A. Exports of Synthetic Rubber

(Long Tons)

Year	SBR-Types	Butyl	Neoprene	N-Type	Total
1954	11,069	2,831	12,062	4,155	30,117
1955					
Jan.	1,381	716	1,046	194	3,337
Feb.	1,331	370	1,049	259	3,009
Mar.	2,162	672	1,287	236	4,357
Apr.	1,807	1,562	1,636	506	5,511
May	3,500	376	1,430	357	5,663
June	6,030	726	1,541	389	8,686
July	5,212	870	1,275	472	7,829
Aug.	7,727	837	1,454	386	9,567
Sept.	8,598	526	1,946	602	11,672
Oct.	7,888	1,041	1,748	444	11,121
Nov.	7,786	894	1,824	306	10,810
Dec.	7,282	1,305	1,862	442	10,891
Total	60,704	9,895	18,098	4,593	93,290
1956					
Jan.	7,550	815	1,757	506	10,628
Feb.	9,018	1,624	1,521	449	12,612
Mar.	10,804	764	1,500	522	13,590
Apr.	10,271	374	1,917	587	13,149
May	10,864	743	2,142	443	14,192
June	9,310	746	2,088	548	12,692
July	9,038	523	1,994	433	11,988
Aug.	9,607	654	2,268	274	12,803

Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.

U.S.A. Automotive Inner Tubes

(Thousands of Units)

	Shipments					
Year	Original Equipment	Replacement	Export	Total	Production	Inventory End of Period
1954	25,090	35,442	948	61,480	58,397	9,299
1955						
Jan.	413	3,629	74	4,116	3,089	8,252
Feb.	352	2,430	80	2,862	2,850	8,243
Mar.	491	2,732	105	3,328	3,234	8,217
Apr.	530	2,635	85	3,250	2,836	7,963
May	531	2,617	85	3,233	3,005	7,735
June	477	3,003	85	3,565	3,136	7,326
July	475	2,915	60	3,450	2,768	6,664
Aug.	394	3,274	65	3,733	2,923	5,917
Sept.	360	2,814	86	3,261	3,169	5,966
Oct.	319	2,595	89	3,004	3,119	6,286
Nov.	355	2,427	93	2,875	3,052	6,734
Dec.	305	2,289	92	2,686	2,719	6,833
Total	5,002	33,360	999	39,363	35,900	
1956						
Jan.	274	3,263	72	3,608	2,918	6,294
Feb.	273	2,548	100	2,921	2,969	6,547
Mar.	282	2,587	93	2,962	3,347	6,848
Apr.	265	2,444	88	2,797	3,094	7,312
May	280	2,515	83	2,878	3,093	7,657
June	269	3,023	79	3,370	2,837	7,349
July	248	3,055	82	3,384	2,300	6,418
Aug.	242	2,954	99	3,295	2,795	5,962
Sept.	213	2,472	91	2,777	2,774	6,056

Source: The Rubber Manufacturers Association, Inc.

U.S.A. Rubber Industry Sales and Inventories

(Million of Dollars)

	Value of Sales*				Manufacturers' Inventories*			
	1953	1954	1955	1956	1953	1954	1955	1956
Jan.	424	348	424	415	866	844	790	935
Feb.	435	351	440	445	868	857	782	970
Mar.	473	388	466	451	880	849	805	979
Apr.	444	375	445	445	874	812	784	970
May	422	357	465	464	888	810	810	985
June	436	377	465	450	914	829	850	975
July	448	374	471	459	925	784	853	987
Aug.	409	337	456	436	897	761	863	1,007
Sept.	416	334	456	...	908	804	874	...
Oct.	395	332	447	...	881	838	902	...
Nov.	346	388	482	...	867	819	935	...
Dec.	369	407	465	...	868	929	934	...
Total	5,017	4,368	5,493	....	Av. 853	831	845	....

Source: Office of Business Economics, U. S. Department of Commerce.
* Adjusted for seasonal variation.

U.S.A. Consumption of Natural and Synthetic Latices

(Long Tons, Dry Weight)

Year	Natural	GR-S*	Neoprene	N-Type	Total Synthetic	Total Natural & Synthetic
1954	75,931	44,173	7,251	4,507	55,931	131,862
1955						
Jan.	7,355	4,537	661	509	5,707	13,062
Feb.	7,066	4,881	689	505	6,075	13,141
Mar.	8,415	5,861	828	512	7,201	15,616
Apr.	7,732	5,209	748	606	6,563	14,295
May	6,643	4,278	768	496	5,542	12,185
June	6,589	4,885	722	591	6,198	12,787
July	5,469	3,830	535	430	4,795	10,264
Aug.	6,784	4,514	770	547	5,831	12,615
Sept.	7,452	5,505	730	595	6,830	14,282
Oct.	7,209	5,704	739	614	7,057	14,266
Nov.	6,620	5,954	829	603	7,386	14,006
Dec.	6,344	5,599	717	587	6,903	13,247
Yr.-end adj.	+2,800	+2,775	.....	+1,900	+4,675	+7,475
Total	86,478	63,982	8,736	8,495	81,213	167,691
1956						
Jan.	6,776	5,858	772	670	7,300	14,076
Feb.	6,399	5,913	787	730	7,430	13,829
Mar.	6,438	5,888	729	781	7,398	13,836
Apr.	5,693	4,923	741	692	6,356	12,049
May	5,239	4,745	778	691	6,214	11,453
June	5,171	4,350	637	657	5,644	10,815
July	4,855	3,731	562	466	4,759	9,614
Aug.	6,374	5,055	816	698	6,569	12,943
Sept.†	5,820	4,572	685	494	5,751	11,571

Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.
† Preliminary. * Includes SBR-Types.

U.S.A. Synthetic Rubber Industry, Wages, Hours

Year	Average Weekly Earnings	Average Weekly Hours	Average Hourly Earnings
1954	$90.76	40.7	$2.23
1955			
Jan.	93.02	40.8	2.28
Feb.	93.07	41.0	2.27
Mar.	94.12	41.1	2.29
Apr.	99.53	42.9	2.32
May	95.22	41.4	2.30
June	96.51	41.6	2.32
July	97.53	41.5	2.35
Aug.	99.96	42.0	2.38
Sept.	100.08	41.7	2.40
Oct.	98.83	41.7	2.37
Nov.	100.14	41.9	2.39
Dec.	100.98	41.9	2.41
1956			
Jan.	101.88	42.1	2.42
Feb.	101.57	41.8	2.43
Mar.	102.51	41.5	2.47
Apr.	102.75	41.6	2.47
May	103.00	41.2	2.50
June	103.41	41.2	2.51
July	104.75	41.9	2.50

Source: BLS, United States Department of Labor.

U.S.A. Rubber Consumption by Main Products

(1,000 Long Tons)

	Transportation			Non-Transportation			
Year	Natural	Synthetic	Total	Natural	Synthetic	Total	Grand Total
1953	358.2	500.3	858.5	195.2	284.6	479.8	1,338.3
1954	386.3	391.0	777.3	210.0	245.7	455.7	1,233.0
1955	409.6	550.3	959.9	225.2	344.6	569.8	1,529.7
1956							
1st quart.	100.8	138.2	239.0	53.3	93.4	146.7	385.7
2nd quart.	91.9	134.3	226.2	47.5	84.6	132.1	358.3

Source: Secretariat of the International Rubber Study Group.

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Rubber Chemist having diversified product experience with at least five years' experience in laboratory or factory. Good starting salary. Excellent opportunity for advancement. Plant located in Pennsylvania. Address Box No. 2015, care of RUBBER WORLD.

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World Production of Natural Rubber

(1,000 Long Tons)

Year	Malaya Estate	Malaya Native	Indonesia Estate	Indonesia Native	All Other	Total
1953	**341.8**	**232.6**	**301.8**	**390.4**	**458.4**	**1,725.0**
1954	**343.5**	**240.8**	**280.5**	**464.3**	**473.4**	**1,802.5**
1955						
Jan.	**29.3**	**27.9**	**23.6**	**17.1**	**42.1**	**140.0**
Feb.	28.5	20.4	22.3	48.1	38.2	157.5
Mar	27.5	26.7	23.0	23.8	39.0	140.0
Apr.	24.2	20.5	20.7	27.4	42.2	135.0
May	27.4	22.4	18.0	30.1	37.1	135.0
June	27.6	22.9	21.3	52.7	40.5	165.0
July	30.3	25.7	21.2	32.5	55.3	165.0
Aug.	30.7	23.6	20.0	43.2	37.5	155.0
Sept.	31.3	24.9	20.3	45.2	45.8	167.5
Oct.	30.8	24.0	22.0	44.8	48.4	170.0
Nov.	30.3	21.9	23.4	37.3	44.6	157.5
Dec.	35.0	27.3	24.5	70.2	50.5	207.5
Total	352.9	286.2	261.3	472.4	521.2	1,895.0
1956						
Jan.	32.6	26.5	23.5	17.4	42.5	142.5
Feb.	27.6	24.3	23.0	20.9	36.7	132.5
Mar.	28.5	22.5	21.5	16.4	41.1	130.0
Apr.	26.7	21.7	20.0	46.1	40.4	155.0
May	23.5	19.8	18.0	38.4	37.8	137.5
June	29.5	23.2	21.9	25.9	44.5	145.0
July	30.8	23.9	21.3	41.5	45.0	162.5
Aug.	30.3	23.0	20.3	64.0	42.4	180.0

Source: BDSA, United States Department of Commerce; Secretariat of the International Rubber Study Group; and United Baltic Corp., Ltd.

World Production of Synthetic Rubber

(1,000 Long Tons)

Year	U.S.A.	Canada	Germany	Total
1953	**848.4**	**80.9**	**6.3**	**935.6**
1954	**622.9**	**86.6**	**6.9**	**716.4**
1955				
Jan.	**69.9**	**8.1**	**0.9**	**78.9**
Feb.	**67.7**	**7.6**	**0.9**	**76.2**
Mar.	**78.5**	**8.7**	**0.8**	**88.0**
Apr.	75.7	7.6	0.8	84.1
May	82.0	8.9	0.9	91.7
June	78.2	8.6	0.9	87.7
July	81.9	8.2	0.9	91.0
Aug.	84.0	8.1	1.0	93.1
Sept.	83.5	9.3	0.9	93.7
Oct.	89.1	9.9	1.0	100.0
Nov.	91.3	9.2	1.0	101.5
Dec.	90.3	9.7	1.0	101.0
Total	970.5	103.9	10.9	1,085.3
1956				
Jan.	93.5	9.7	1.0	104.3
Feb.	90.5	8.2	1.0	99.7
Mar.	94.4	10.3	1.1	105.8
Apr.	91.6	10.3	1.0	102.8
May	93.7	10.6	1.0	105.3
June	85.3	10.4	0.6	96.3
July	88.0	8.7	1.0	97.7
Aug.	86.5	10.2	..	...

Source: Secretariat of the International Rubber Study Group; and BDSA United States Department of Commerce.

U.S.A. Synthetic Rubber Exports, by Country (Including Latices)

January-July, 1956
(Long Tons)

Country	SBR-Types	Butyl	Neoprene	N-Type	Total
U.K.	10,758	259	2,153	446	13,616
Belgium	2,285	333	2,921	123	5,662
France	7,904	1,602	584	426	10,516
Germany	6,763	1,365	1,422	382	9,932
Italy	3,766	134	935	404	5,239
Australia	5,967	174	236	48	6,425
Canada	4,766	4	1,773	169	6,712
Japan	1,630	372	1,287	635	3,924
Mexico	5,135	449	108	67	5,759
South Africa	4,762	249	288	29	5,328
All others	13,091	647	1,213	759	15,740
Total	66,854	5,588	12,920	3,488	88,850

Source: Secretariat of the International Rubber Study Group.

World Consumption of Natural Rubber

(1,000 Long Tons)

Year	United States	U.S.S.R.* and China	United Kingdom	Other Foreign	Total Foreign	Grand* Total
1951	454.0	136.3	234.2	675.5	1,046.0	1,500.0
1952	453.8	146.8	197.3	652.1	996.2	1,450.0
1953	553.5	101.9	206.6	753.0	1,061.5	1,615.0
1954	597.5	62.7	226.5	835.7	1,124.9	1,725.0
1955						
Jan.	56.9	7.8	23.5	71.8	103.1	160.0
Feb.	51.0	....	20.1	....	89.0	140.0
Mar.	58.5	7.3	21.4	72.8	101.5	160.0
Apr.	53.0	....	23.3	....	104.5	157.5
May	54.7	....	20.5	....	97.8	152.5
June	56.3	2.8	18.3	80.1	101.2	157.5
July	46.2	1.8	18.3	73.7	93.8	140.0
Aug.	48.4	0.1	16.0	65.5	81.6	130.0
Sept.	51.0	2.1	19.8	72.1	94.0	145.0
Oct.	55.0	10.4	22.9	76.7	110.0	165.0
Nov.	52.8	17.1	20.0	77.6	114.7	167.5
Dec.	51.2	5.2	22.2	83.9	111.3	162.5
Total	634.8	56.2	246.3	900.2	1,202.7	1,837.5
1956						
Jan.	53.4	14.4	21.7	73.0	109.1	162.5
Feb.	50.1	19.1	17.9	72.9	109.9	160.0
Mar.	49.6	11.7	16.0	73.7	100.4	150.0
Apr.	**47.0**	**14.6**	**18.4**	**72.5**	**105.5**	**152.5**
May	48.3	16.8	14.5	75.4	106.7	155.0
June	43.6	20.8	16.1	82.0	118.9	162.5
July	38.4	16.6	14.7	75.3	106.6	145.0
Aug.	46.1	7.1	10.3	74.0	91.4	137.5

Source: BDSA, United States Department of Commerce; Secretariat of the International Rubber Study Group; and United Baltic Corp., Ltd.
* Estimated.

World Consumption of Synthetic Rubber*

(1,000 Long Tons)

Year	U.S.A.	Canada	United Kingdom	Total† Continent of Europe	World† Grand Total
1953	784.8	35.9	4.9	39.3	872.5
1954	636.7	30.1	8.7	50.8	740.0
1955					
Jan.	68.4	2.6	1.2	5.8	80.0
Feb.	67.6	3.1	1.1	5.5	77.5
Mar.	77.1	3.4	1.2	6.0	90.0
Apr.	72.1	3.0	1.5	5.8	85.0
May	75.7	3.3	1.4	6.0	87.5
June	80.2	3.8	1.5	6.5	92.5
July	63.3	2.7	1.4	6.3	75.0
Aug.	73.3	2.7	1.5	6.3	87.5
Sept.	76.7	3.7	1.9	7.0	92.5
Oct.	80.4	3.6	2.6	7.5	97.5
Nov.	81.7	4.4	2.4	8.0	97.5
Dec.	80.5	4.0	2.7	7.8	95.0
Total	894.9	40.2	20.5	78.3	1,057.5
1956					
Jan.	78.5	4.0	3.1	8.8	97.5
Feb.	75.2	4.1	3.1	8.5	95.0
Mar.	78.3	4.1	3.1	8.8	97.5
Apr.	73.7	4.4	3.6	8.5	95.0
May	76.4	4.5	3.2	8.3	97.5
June	67.8	4.0	3.6	9.0	87.5
July	58.2	3.7	2.9	8.3	77.5
Aug.	71.5	3.3	2.3	..	90.0

Source: Secretariat of the International Rubber Study Group; BDSA, United States Department of Commerce.
* Includes latices.
† Figures estimated or partly estimated.

Canadian Rubber Consumption By Main Products

(Long Tons)

	1955	First Quarter 1956	Second Quarter 1956
Tires and tubes	55,824	14,820	15,986
Wire and cable	2,460	834	970
Footwear	8,148	2,017	2,053
Miscellaneous	18,096	4,506	4,769
Total	84,528	22,177	23,778

Source: Secretariat of the International Rubber Study Group.

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	Shipments					
	Original Equipment	Replacement	Export	Total	Production	Inventory End of Period
Passenger Car						
1953	33,106	45,798	809	79,713	81,455	13,044
1954	29,746	47,043	928	77,717	76,806	12,228
1955						
Jan.	3,481	4,139	79	7,699	7,797	12,363
Feb.	3,540	3,551	83	7,174	7,549	12,643
Mar.	4,326	4,255	104	8,685	8,810	12,874
Apr.	3,967	4,677	88	8,733	8,000	12,197
May	3,871	4,705	87	8,663	8,742	12,235
June	3,482	5,399	97	8,979	9,383	12,698
July	3,461	4,802	76	8,339	7,893	12,199
Aug.	2,984	5,058	60	8,103	7,585	11,636
Sept.	2,749	4,366	74	7,189	7,882	12,407
Oct.	3,172	3,556	74	6,802	8,160	13,806
Nov.	3,900	2,902	63	6,865	8,198	15,142
Dec.	3,641	2,746	81	6,467	7,223	15,963
Total	42,574	50,156	966	93,698	97,232	
1956						
Jan.	2,958	4,040	66	7,064	7,661	16,546
Feb.	2,919	3,387	90	6,396	7,571	17,701
Mar.	3,027	4,372	65	7,464	7,812	18,096
Apr.	2,787	4,994	67	7,847	7,530	17,649
May	2,349	5,203	65	7,617	7,628	17,714
June	2,162	5,659	64	7,885	6,600	16,443
July	2,471	5,482	73	8,026	5,669	14,088
Aug.	1,953	5,359	77	7,389	6,897	13,578
Sept.	1,262	4,427	70	5,758	6,647	14,468
Truck and Bus						
1953	4,843	9,326	734	14,904	14,696	2,676
1954	3,592	8,111	826	12,529	12,347	2,546
1955						
Jan.	303	827	81	1,211	1,243	2,586
Feb.	294	730	74	1,098	1,196	2,678
Mar.	454	672	96	1,222	1,273	2,734
Apr.	489	639	76	1,204	1,153	2,693
May	481	655	65	1,202	1,208	2,701
June	449	730	76	1,255	1,320	2,763
July	429	909	51	1,389	1,134	2,485
Aug.	378	922	59	1,359	1,132	2,272
Sept.	393	804	66	1,264	1,243	2,268
Oct.	324	904	88	1,315	1,395	2,357
Nov.	403	690	87	1,180	1,405	2,584
Dec.	404	552	91	1,047	1,255	2,815
Total	4,801	9,034	910	14,746	14,957	
1956						
Jan.	444	629	65	1,139	1,318	2,971
Feb.	424	565	88	1,077	1,326	3,232
Mar.	439	662	62	1,163	1,382	3,465
Apr.	430	767	74	1,271	1,303	3,483
May	421	777	65	1,264	1,358	3,582
June	372	968	65	1,404	1,329	3,504
July	362	837	73	1,272	1,073	3,306
Aug.	349	820	86	1,254	1,154	3,217
Sept.	291	811	92	1,194	1,153	3,180
Total Automotive						
1953	37,949	55,124	1,543	94,617	96,150	15,720
1954	33,338	55,154	1,754	90,246	89,153	14,774
1955						
Jan.	3,785	4,967	159	8,911	9,040	14,949
Feb.	3,833	4,281	157	8,272	8,745	15,321
Mar.	4,780	4,926	201	9,907	10,083	15,609
Apr.	4,457	5,315	165	9,937	9,153	14,890
May	4,352	5,361	152	9,865	9,949	14,936
June	3,931	6,129	174	10,234	10,703	15,460
July	3,890	5,711	128	9,729	9,027	14,684
Aug.	3,362	5,980	119	9,462	8,717	13,908
Sept.	3,142	5,171	140	8,453	9,125	14,675
Oct.	3,495	4,460	161	8,117	9,555	16,163
Nov.	4,303	3,592	150	8,045	9,603	17,727
Dec.	4,045	3,298	172	7,515	8,478	
Total	47,375	59,191	1,878	108,447	112,178	
1956						
Jan.	3,402	4,669	131	8,203	8,979	19,517
Feb.	3,343	3,953	178	7,473	8,897	20,934
Mar.	3,466	5,034	127	8,627	9,193	21,562
Apr.	3,217	5,761	141	9,119	8,834	21,132
May	2,770	5,980	130	8,880	8,987	21,296
June	2,533	6,627	129	9,289	7,930	19,947
July	2,833	6,319	146	9,298	6,741	17,394
Aug.	2,303	6,179	163	8,644	8,050	16,795
Sept.	1,553	5,238	162	6,952	7,800	17,648

Source: The Rubber Manufacturers Association, Inc.

U.S.A. Rubber Industry Employment, Wages, Hours

Year	Production Workers (1000's)	Average Weekly Earnings	Average Weekly Hours	Average Hourly Earnings	Consumers Price Index
		All Rubber Products			
1939	121	$27.84	39.9	$0.75	
1954	195	78.21	39.7	1.97	114.8
1955					
Apr.	211.6	86.11	41.8	2.06	114.2
May	214.4	86.94	41.8	2.08	114.2
June	220.0	88.83	42.3	2.10	114.4
July	216.9	86.52	41.2	2.10	114.7
Aug.	219.0	86.32	41.3	2.09	114.5
Sept.	223.1	86.74	41.5	2.09	114.9
Oct.	226.4	89.04	42.0	2.12	114.9
Nov.	231.2	92.01	42.4	2.17	115.0
Dec.	233.9	89.21	41.3	2.16	114.7
1956					
Jan.	232.5	87.91	40.7	2.16	114.6
Feb.	227.6	85.81	40.1	2.14	114.6
Mar.	224.7	84.93	39.5	2.15	114.7
Apr.	224.6	85.79	39.9	2.15	114.9
May	215.9	86.18	39.9	2.16	115.4
June	211.3	84.93	39.5	2.15	116.2
July	207.3	86.37	39.8	2.17	117.0
Aug.	209.3	...	...	...	116.8
		Tires and Tubes			
1939	54.2	$33.36	35.0	$0.96	
1954	79.7	87.85	38.7	2.27	
1955					
Apr.	88.4	101.28	42.2	2.40	
May	90.1	100.91	41.7	2.42	
June	91.0	105.60	43.1	2.45	
July	91.5	103.82	42.7	2.42	
Aug.	91.0	102.72	42.1	2.44	
Sept.	91.9	101.02	41.4	2.44	
Oct.	92.3	103.74	42.0	2.47	
Nov.	94.2	106.26	42.0	2.53	
Dec.	94.7	99.50	39.8	2.50	
1956					
Jan.	94.1	101.00	40.4	2.50	
Feb.	93.7	97.71	39.4	2.48	
Mar.	93.3	97.89	39.0	2.51	
Apr.	91.8	98.00	39.2	2.50	
May	91.6	99.00	39.8	2.51	
June	90.1	98.25	39.3	2.50	
July	89.2	98.39	39.2	2.51	
		Rubber Footwear			
1939	14.8	$22.80	37.5	$0.61	
1954	20.7	67.43	39.9	1.69	
1955					
Apr.	21.2	70.99	40.8	1.74	
May	21.4	70.64	40.6	1.74	
June	21.6	71.34	41.0	1.74	
July	21.8	71.93	41.1	1.75	
Aug.	21.5	67.25	39.1	1.72	
Sept.	23.5	67.60	39.3	1.72	
Oct.	24.4	69.20	40.0	1.73	
Nov.	25.5	77.89	42.1	1.85	
Dec.	26.2	74.89	40.7	1.84	
1956					
Jan.	26.2	74.37	40.2	1.85	
Feb.	26.1	74.74	40.4	1.85	
Mar.	25.8	71.16	39.1	1.82	
Apr.	20.3	72.25	39.7	1.82	
May	20.0	72.25	39.7	1.82	
June	19.4	70.53	39.4	1.79	
July	18.9	71.28	39.6	1.80	
		Other Rubber Products			
1939	51.9	$23.34	38.9	$0.61	
1954	94.3	71.91	40.4	1.78	
1955					
Apr.	101.1	76.13	41.6	1.83	
May	105.0	78.31	42.1	1.86	
June	106.4	77.93	41.9	1.86	
July	103.6	73.84	39.7	1.86	
Aug.	104.3	75.85	41.0	1.85	
Sept.	107.7	78.96	42.0	1.88	
Oct.	109.7	80.56	42.4	1.90	
Nov.	111.5	83.03	42.8	1.94	
Dec.	113.0	83.69	42.7	1.96	
1956					
Jan.	112.2	79.73	41.1	1.94	
Feb.	107.8	77.95	40.6	1.92	
Mar.	105.6	76.99	40.1	1.92	
Apr.	106.6	77.95	40.6	1.92	
May	104.7	76.40	40.0	1.91	
June	99.0	76.02	39.8	1.91	
July	99.2	78.38	40.4	1.94	

Source: BLS, United States Department of Labor.

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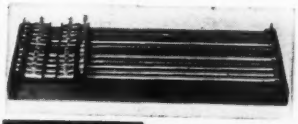

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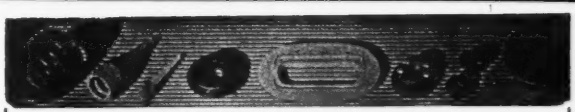

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Production of Cotton, Rayon, and Nylon Tire Fabrics

(Thousands of Pounds)

	Cotton				Rayon				
	Tire Cord Not Woven	Tire Cord Fabric Woven	Chafer and All Other Tire Fabrics	Total	Tire Cord Not Woven	Tire Cord and Other Tire Fabrics	Total	Nylon Tire Cord and Fabrics	Total* Synthetic Tire Cord and Fabrics
1954									
Jan.-Mar.	‡	2,585	13,229	15,814	17,297	73,068	90,365	5,320	95,685
Apr.-June	‡	4,067	12,830	16,897	12,436	66,796	79,232	8,357	87,589
July-Sept.	‡	2,104	9,321	11,425	12,851	50,136	62,987	6,754	69,741
Oct.-Dec.	‡	3,743	12,476	16,219	14,609	76,931	91,540	9,338	100,878
Total	‡	12,499	47,856	60,335	57,193	266,931	324,124	29,769	353,893

	Cotton and Nylon[a]		Rayon Tire Cord		
	Cotton Chafer Fabrics and Other Tire Fabrics	Cotton and Nylon Tire Cord and Fabric	Woven	Not Woven	Total All Tire Cord and Fabrics
1955					
Jan.-Mar.	12,763	14,870	79,191	20,299	127,123
Apr.-June	12,728	18,527	80,908	21,550	133,713
July-Sept.	12,941	16,093	81,996	20,740	131,770
Oct.-Dec.	12,333	15,754	77,600	24,343	130,030
Total	50,765	65,244	319,695	86,932	522,636
1956					
Jan.-Mar.	12,815	16,483	74,833	23,707	127,838
Apr.-June	10,322	19,471	61,196	21,557	112,546
July-Sept.	7,958	18,637	57,076	18,698	102,669

* Fuel cell fabrics not included with rayon and nylon tire cord and fabrics.
† Included with "Chafer and All Other Tire Fabrics" to avoid disclosing data for individual mills.
‡ Included with "Tire Cord Fabric Woven" to avoid disclosing data for individual mills.
[a] Cotton and nylon figures combined to avoid disclosing data for individual companies.
Source: Bureau of the Census, United States Department of Commerce.

Carbon Black Statistics—First Nine Months, 1956

Furnace blacks are classified as follows: SRF, Semi-reinforcing furnace black; HMF, high modulus furnace black; FEF, fast-extruding furnace black; HAF, high abrasion furnace black; SAF, semi-abrasion furnace black.

(Thousands of Pounds)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Production									
Furnace types									
Thermal	11,874	11,478	12,127	10,665	11,712	11,483	11,577	12,413	11,927
SRF	34,047	30,367	31,692	28,711	31,622	29,081	30,860	29,504	29,107
HMF	10,401	8,681	7,984	8,764	8,972	8,066	7,479	8,437	8,394
FEF	20,776	19,518	21,359	19,948	18,339	20,118	17,890	15,270	14,995
HAF	36,802	36,807	38,058	33,832	38,830	37,542	38,334	35,679	31,211
SAF, ISAF	13,918	13,555	16,228	20,145	17,149	16,172	14,250	16,458	21,526
Total furnace	127,818	120,406	127,448	122,065	126,624	122,462	120,390	117,761	117,160
Contact types	32,222	28,717	31,552	30,460	30,613	29,011	30,120	29,782	30,144
Totals	160,040	149,123	159,000	152,525	157,237	151,473	150,510	147,543	147,304
Shipments									
Furnace types									
Thermal	11,846	11,361	11,204	10,242	10,376	8,327	8,326	10,917	12,580
SRF	32,165	26,973	27,492	25,239	26,646	19,893	20,242	22,109	25,682
HMF	9,453	8,420	9,051	9,184	8,068	8,483	7,519	8,195	8,987
FEF	19,381	16,379	17,559	18,369	17,413	15,054	14,311	16,340	18,576
HAF	36,934	35,142	36,374	31,287	37,319	32,698	33,799	34,502	35,328
SAF, ISAF	14,500	14,762	15,637	15,015	14,517	13,055	13,610	13,962	15,366
Total furnace	124,279	113,037	117,317	109,336	114,339	97,510	97,807	106,025	116,519
Contact types	33,256	31,548	30,377	31,032	31,582	29,609	28,661	32,500	35,352
Totals	157,535	144,585	147,694	140,368	145,921	127,119	126,468	138,525	151,871
Producers' Stocks, End of Period									
Furnace types									
Thermal	6,013	6,130	7,053	7,476	8,812	11,968	15,219	16,715	16,062
SRF	21,021	24,415	28,615	32,087	37,063	46,251	56,869	64,264	67,689
HMF	21,304	21,565	20,498	20,078	20,982	20,565	20,525	20,767	20,174
FEF	24,957	28,096	31,896	33,475	34,401	39,465	43,044	41,974	38,393
HAF	36,323	37,988	39,672	42,217	43,728	48,572	53,107	54,284	50,167
SAF, ISAF	26,669	25,462	26,053	31,133	33,815	36,932	37,572	40,068	46,228
Total furnace	136,287	143,656	153,787	166,516	178,801	203,753	226,336	238,072	238,713
Contact types	95,294	92,463	93,638	93,066	92,097	91,499	92,958	90,240	85,032
Totals	231,581	236,119	247,425	259,582	270,898	295,252	319,294	328,312	323,745
Exports									
Furnace types	21,806	24,725	24,105	17,295	19,647	22,922	17,545	18,630	.....
Contact types	11,886	15,097	12,607	14,957	12,189	14,662	12,767	16,773	.....
Totals	33,692	39,822	36,712	32,252	31,836	37,584	30,312	35,403	.....

Source: Bureau of Mines, United States Department of the Interior, Washington, D. C.

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As we near the close of a most pleasant year we extend to all our customers and other friends a message of happiness and good cheer.

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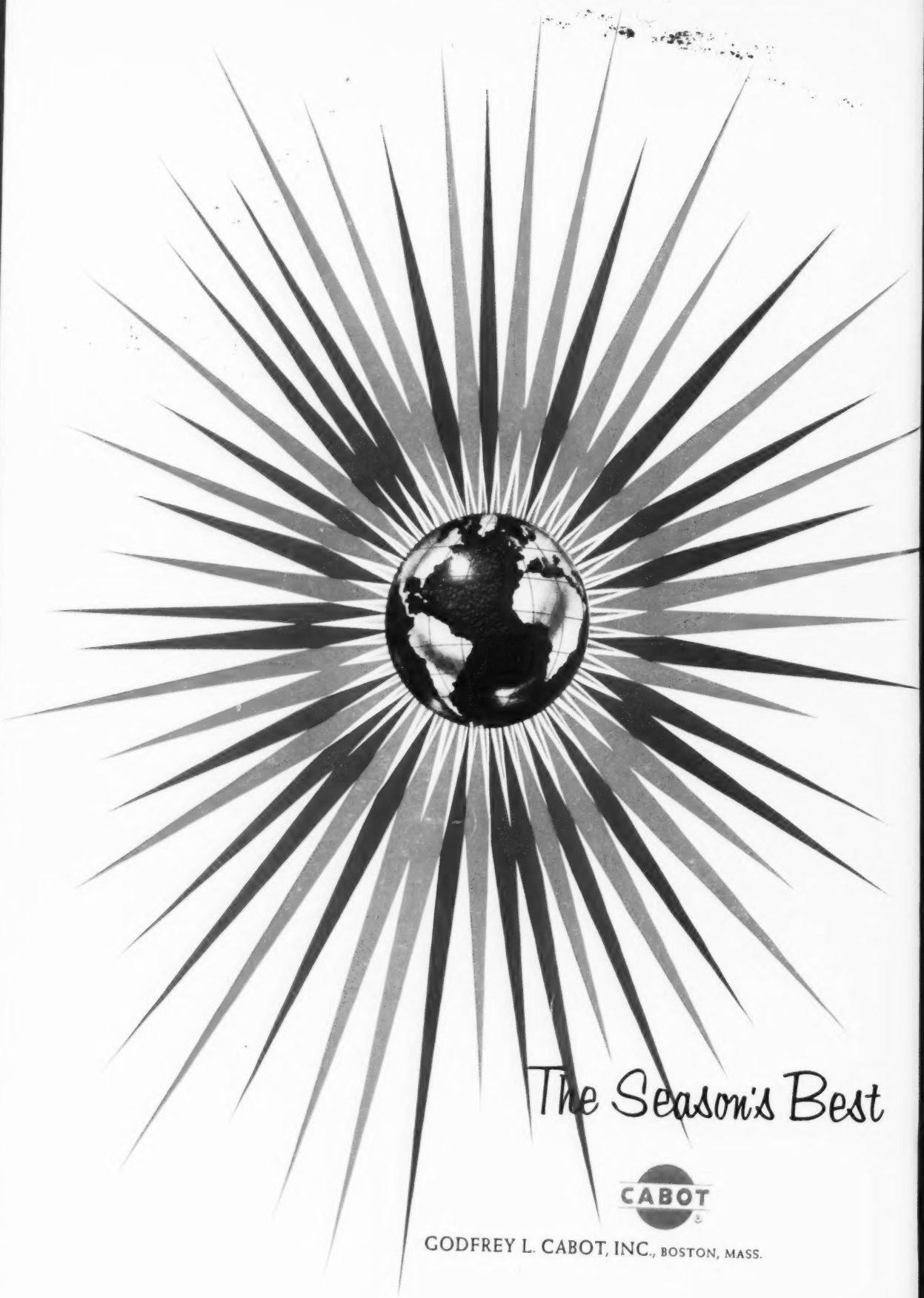
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